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Archives of PHYSICAL MEDICINE *and* REHABILITATION

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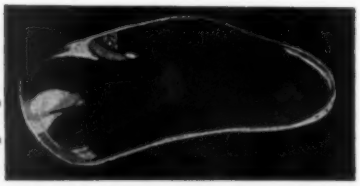

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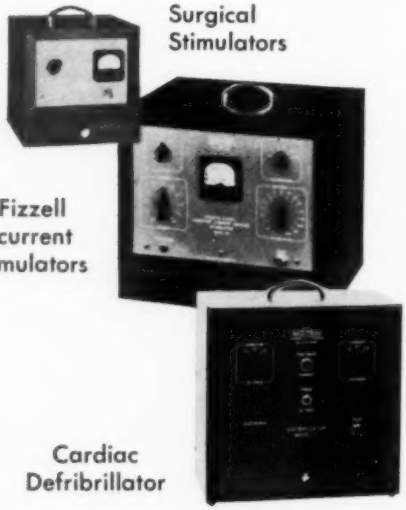

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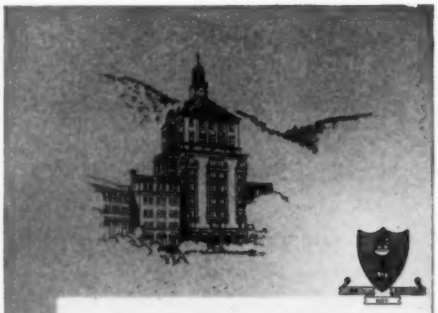

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Relationships of Rehabilitation Centers to Referring Physicians, Medical Societies, Medical Schools and Hospitals

H. Worley Kendell, M.D.
and
Joseph N. Schaeffer, M.D.
Peoria, Ill.

At the last annual conference of rehabilitation centers held in Louisville in December, 1954, there was a committee report on relationships and affiliation of rehabilitation centers with medical schools and hospitals. This report was accepted by the conference as reflecting the opinion of the members. Much of this report is applicable to this discussion. The introductory remarks consisted of several assumptions that are listed as a frame of reference for this paper.

1. The rehabilitation center is a unit of the general community health facilities. In this concept it is not construed that the rehabilitation center must be an integral part of the physical or financial structure of a hospital; however, it should be considered as a part of the armamentarium for the medical-social welfare of that community. The center's role is determined by the services rendered.
2. In a broad-scope rehabilitation center there is a welding of all appropriate disciplines for the purpose of enabling a disabled person to be as self-sufficient as possible.
3. There is an increasing awareness on the part of physicians, educators and the public of the need to return an individual from illness or injury to the best adjusted level in the family unit.
4. Every rehabilitation center varies as to physical structure, plan of organization, services rendered, and emphasis of interest. This is based on origin, background, struggle for survival, demands of the community and other related factors. Some centers are principally educational facilities, some physical conditioning, and others strictly medical, still others offer a combination of services.

Role of the Physician in the Center

It can be seen that a rehabilitation center is considered a part of the community health facilities. The concept that something less than health exists in the individual who needs the services of a rehabilitation center immediately brings the physician into the picture as a key figure in the process of rehabilitating the disabled. The absence of health implies illness or injury. This may seem like such a basic assumption that it should not have been mentioned, but a significant number of key individuals in the country's rehabilitation centers have jealously de-emphasized the role of the physician in their institutions. Although all centers recognize that certain aspects of rehabilitation should be directed by the physician, the methods of obtaining this medical direction vary greatly. Some centers have full-time medical direction; on the other end of the scale are the centers that allow the referring physician, no matter what his training or interest, to prescribe the medical part of the program. In these latter type centers, where the therapists and nonmedical personnel actually prescribe treatment with only a bare minimum of medical supervision, less than adequate medical services are furnished the patient.

Why have such centers resisted adequate medical direction? Part of the fault has been with the medical profession itself. Not enough physicians have had the experience or training to prescribe intelligently the medical portion of a rehabilitation program. Hence, when a physician other than a physiatrist has

Part of the **Symposium on Rehabilitation Centers** presented at the Thirty-third Annual Session of the American Congress of Physical Medicine and Rehabilitation, Detroit, August 31, 1955.
From the Institute of Physical Medicine and Rehabilitation.

had the responsibility for medical direction, the tendency has been to allow the therapist to proceed, carte blanche, with any type treatment he felt might help the patient.

Another fault is the failure to accept and realize that other disciplines are as important as medicine in returning patients to an adjusted place in the community. A physician might be well trained in prescription of the various therapies needed for physical restoration, but if he overemphasized the physical aspects and blocked the psychological, social, and vocational services, he would not be a good medical director of a rehabilitation center. Of course, a factor in avoiding integral medical direction which is present but seldom stated is the feeling on the part of a center director that the physician will take from him part of the authority and prestige that is due him as a result of his position. Many center directors have struggled to build up an organization, frequently without too much help from the medical profession. It is difficult for them to accept a physician who merely has to step into a high position in the organization and who, if not indoctrinated, might destroy a fine balance of the varied services offered by the center.

Directors of rehabilitation centers have given many reasons for not providing integral medical direction. Some have said that their centers operate on such a small scale and with a limited budget that they feel they cannot pay for the services of a full-time or even part-time medical director. Others state that qualified physicians are not available. The most damning criticism of integral medical direction comes from directors who have had unfortunate experiences with physicians. Some physicians have taken on the job as medical director and then have antagonized other members of the medical profession by using their position to build up a private practice or by failing to provide adequate information to the referring physician. In other words, they have allowed professional jealousies to arise.

Relationship of Center to Referring Physician

The easiest way to antagonize the referring physician is to have him feel that the center medical director is "stealing his patients." If he gets this impression, his referral of patients to the center will cease. The director must lean over backward to keep the family physician informed as to the progress of his patient. Since the family physician must be responsible for the continued long-time care of the patient, the more he knows from the beginning the better long-range program he will be able to provide. He must be consulted frequently regarding change in treatment or program. In other words, he must become a part of the rehabilitation team. Although this constant exchange of information between the center medical director and the referring physician takes time, the time is well spent because it helps provide better services to the patient as well as helps to indoctrinate the referring physicians in the concept and philosophy of rehabilitation.

One of the best methods of establishing good working relationships with referring physicians, especially in centers with integral medical direction, is for the medical personnel to be well-trained physicians completely conversant with their specialties and the prescription of the various therapies. When the referring physicians realize that such individuals are available to provide services for their patients, they will use the center to the maximum. Contrariwise, if the medical directors are not well trained and cannot compare favorably with other specialists of similar age and experience, the center will not be attractive to other physicians seeking the best for their patients.

Rehabilitation directors, whether medical or nonmedical, have found that the best person to establish ideal relationships with referring physicians and organized medicine is the medical director or, in those centers without such a person, another physician with the center's best interests at heart.

Relationship of Center to County Medical Societies

The relationship with the county medical societies also must be handled diplomatically. A new center should have the support of all the county medical societies in the area from which it will draw patients. The organizational plan of the center plus its operating policies should be presented to the societies for comment. The center must have approval by organized medicine of all policies that involve the ethics of medical practice. Usually if medical organizations are aware of all the details of a center and can be a part of its planning, they will support it, but if they are informed of its existence after the center is in operation and then asked for help, they will look for reasons to defeat the purpose for which the center is developed. The formation of a medical advisory committee selected at least in part by the local societies will make the society membership realize that they are a part of the development of a new health facility.

Members of a medical advisory committee should be changed frequently in order that more of the private practitioners can learn of the functions, problems, and plans of the center. Probably the best method of rotating committee members is to have them serve for three years with one third going off the committee each year. In this way continuity of advice is maintained but new blood is added periodically.

The meetings of the medical advisory committee should be regular affairs with a well-planned agenda and conducted in a business-like manner. The ability to lead such a meeting is an important attribute. If the busy practitioners are made to realize the value of their support and advice in conducting a center in a snappy, well-organized meeting, they will be more apt to attend the sessions and become strong supporters of the program. If they attend a meeting where only vague generalities are discussed with no concrete decisions arrived at, they will be prone to be "knockers" instead of "boosters."

Relationship of Center to Medical Schools and Hospitals

Some centers have no direct relationship with medical teaching facilities such as hospitals or medical schools. Perhaps for a particular center, there need be no connection. Systems of affiliation include the center that is within the physical plant of the medical facility and operates on the basis of a written working agreement, the center that has no physical affiliation with the medical facility but operates on a written agreement, and the center that has only informal working relationships with the medical facility.

Some of the advantages and disadvantages of developing special working relationships, as outlined at the last conference of rehabilitation centers, are as follows:

Advantages

1. Training of professional personnel.
2. Mutual exchange of ideas that stimulate professional growth.
3. Provides atmosphere for the team approach.
4. Consolidation of physical facilities may reduce cost of operation.
5. Service to patients from students under supervision.
6. Source of personnel for affiliating centers.
7. Encourages recruitment of students.
8. When directly affiliated with a medical school, the center may have a subtle impact on the teaching curriculum.
9. May facilitate earlier development of the total rehabilitation services to the patient.
10. May release hospital beds designed for acute cases.
11. Broadens the scope of operation of the center.
12. Provides opportunity and material for research.
13. Prestige.
14. May benefit from special grants and endowments.

Disadvantages

1. Danger of overemphasis on the physical aspect of disability.
2. Acute hospital atmosphere may not

be conducive to the philosophy of total rehabilitation.

3. May limit expansion of physical plant.
4. May increase cost of operation.
5. May cause loss of referrals from the physicians not affiliated with the hospital.
6. May affect established endowments, legacies, and memorials.
7. May affect the relationship and support of community agencies.
8. May be a sacrifice of staff time for teaching purposes.
9. Instances may arise when obligations for special services will interfere with a comprehensive rehabilitation program.
10. May cause the center to lose its identity as a special facility.

The members of the conference of Rehabilitation Centers expressed a general opinion that there is a need for the expansion of existing facilities and development of comprehensive rehabilitation centers. The conferees felt that three elements should be contained in these facilities: first, service to patients; second, educational programs (highlighting the training of professional personnel); third, research and study programs. Hence, the logical conclusion is that, where service to patients can be maintained and improved, affiliation with medical educational facilities should be encouraged in order to enhance education and research.

THE AMERICAN ASSOCIATION OF ELECTROMYOGRAPHY AND ELECTRODIAGNOSIS

Third Annual Scientific Session

Sunday, September 9, 1956 • The Ambassador, Atlantic City, N. J. • Surf Room

8:00 A.M. Registration.

9:30 A.M. Electromyography in Private Practice. *James L. Golseth.*
The Value of Electromyography in a Military Hospital. *B. L. Crue.*
An Evaluation of Certain Practical Aspects of Clinical Electromyography. *J. B. Rogoff, and Edward F. Delagi.*
Electromyography in the Diagnosis of Acute Polyneuritis with Particular Reference to this Disease and Industrial Injuries. *A. A. Marinacci, and Carl W. Rand.*
Isolated Musculocutaneous Nerve Injury-Traumatic (Case History). *Lewis A. Leavitt.*
Unusual Clinical Contributions in Electromyography. *Y. T. Oester, and Arthur A. Rodriquez.*
Electromyographic Studies of Six Patients Having an Unusual Myasthenic Syndrome. *Edward H. Lambert; L. M. Eaton, and E. D. Rooke.*

LUNCHEON

1:30 P.M. Electrovasography — A Quantitative Diagnosis Adjunct in Peripheral Vascular Disease. *Lewis Cohen.*
Unit Potential Patterns in Poliomyelitis. *Ernest F. Adams, and G. Clinton Knowlton.*
Studies in Cross-Education. *R. Gregg; A. Mastellone, and J. W. Gersten.*
Electromyographic Study of Extraocular Muscles in Man. *Joseph Moldaver, and Goodwin M. Breinin.*
Variations of the Electromyographic Pattern in Myogenic Disease. *Max Karl Newman.*
Quantitative Study of Knee Jerks by Electromyography. *Gerald Hirschberg, and Phillip Bergman.*
Electric Activity of the Resting Muscles in Progressive Muscular Dystrophy. *L. D. Amick; Edward H. Lambert, and J. A. Bastron.*

4:30 P.M. Business Meeting — Surf Room.

6:00 P.M. Social Hour and Dinner — Room 110.

Organization and Administration of a Community Rehabilitation Center

Vivian Shepherd
Kansas City, Mo.

Recent years have seen increasing interest and concern on the part of the general public toward the problems of the disabled and the seriously handicapped. This concern has led to community study and planning for services to these groups out of which has come a great interest in community rehabilitation centers. Usually, as in promotion of any community activity, a small incubating coterie of intensely interested persons gives leadership in community organization for the center. If through the efforts of this group the community needs have been studied sufficiently to warrant the beginning of a center, a great amount of community education and interest will already have been accomplished through the many groups and agencies involved in a survey or study of community needs for the handicapped. Often this interest can be fostered by a group such as the health council of the local council of social agencies. When such a framework is used, there is already a wide representation, both lay and professional, of persons and agencies concerned with the needs of the local community which, after study, can recommend the formation of a center.

One of the major points in organization for a center and its progress after formation is to create widespread interest and participation by as many groups as possible. This can be accomplished by planning groups, a board, and committees that are truly representative of the many widely diverse groups in the community. Active support and interest must be obtained from such groups as the local medical society, official agencies concerned with rehabilitation and welfare, voluntary health organizations that have a stake in the rehabilitation of the group of disabilities they represent, community agencies, civic and church groups, labor organizations, and business and industrial groups.

The benefit from this wide-spread interest and support is tremendous. Usually community rehabilitation centers are privately organized within the community they serve and come into being only when community need and support are sufficient; they are built and financed by community funds. In our democratic society, community rehabilitation centers are a completely natural development. Community sponsored, community financed, and community controlled, they are close to the people. The participation of these individuals and groups also provides a situation wherein a great many citizens come to have a first-hand understanding and appreciation of what rehabilitation really is. They come to grips with the problem and they learn what disability means to a community. What they learn is communicated again and again to the public through many channels. Only through such education and understanding can services to the disabled become adequately supported.[1]

The kind of community relationship to be developed and maintained must be warm and dynamic; groups and individuals should have a feeling of being an integral part of planning, promotion, and progress. Many ways of developing such relationship for various purposes are useful but nothing can compete with personal contact made by the staff, board, and volunteers. In order to get the kind of support needed, particularly in the early stages of growth, many face-to-face contacts must be made and this may involve the staff, officers, and friends of the organization.

Many types of activities for fostering good community understanding and support are available. These include interagency conferences; publication of informational and educational material,

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Part of the **Symposium on Rehabilitation Centers** presented at the Thirty-third Annual Session of the American Congress of Physical Medicine and Rehabilitation, Detroit, August 31, 1955.

Executive Director, The Rehabilitation Institute.

annual reports, newsletters, and bulletins in the journals and news organs of medical and lay groups. Radio and television can be utilized for live shows or recordings, slides, and films of the activities of the center. Demonstrations and exhibits can be prepared for various medical and lay groups. Field trips to the center by students of nursing schools; of physical, occupational, and speech therapy classes; and of other related fields should be encouraged. Advisory committees can be established to consider such problems as public relations, finance, employment of the handicapped, and medical management. Volunteers can be recruited for routine and special duties.

The foregoing are but suggestions as to types of activities toward community organization and support of a rehabilitation center. The actual program will vary from community to community dependent upon the needs, leadership, and ingenuity available. Good community relationships are a necessity and entail a never-ending awareness of all the aspects of the center program and its impact upon the community as a whole. To have a good program is not enough; others must know about it in order to provide for and use its services for the rehabilitation of the disabled. This can be accomplished only through a constant program of strengthening community relationships. Also, if the center is to achieve its avowed purpose it must be administered carefully and efficiently.

Administration

The following statements on the administration of a rehabilitation center are an adaptation of a portion of an excellent book, *Principles of Hospital Administration* (Revised edition) by John R. McGibony.

Center operation and administration is growing more complex with the rapid expansion of interest in rehabilitation, scientific progress, and consequent increase in demands for rehabilitation center service. Centers must keep abreast of this progress. As the center takes its place in the life of the community, there is urgent need for efficient administration, but this does not mean in business practices alone, important as this may be.

Most rehabilitation centers have a board of directors of representative citizens who set the over-all policies of the center and who, in turn, delegate to an executive director the responsibility of carrying out its expressed policies. The executive director's responsibilities are most intimately connected with the center's place in the community. It might well be said that the center's obligations are virtually the same as the director's. The director is often the personification of the center to the community.

For these reasons, it is imperative that great care be exercised by the board of directors in the selection of the person who will direct the formation and progress of the center program. It is also imperative that the executive director and the medical director be chosen early in the planning stage so that guidance and counsel will be available to the board as it makes decisions that will affect the future success of the center.

There must be a careful delineation of responsibility and duties between the board of directors and the executive director at the very beginning. The board expects to be kept fully informed of the results produced by methods used and details used to obtain them. The board expects counsel from the executive director in the formulation of policy. His familiarity with detail of operation makes his advice invaluable in this respect. Likewise his presence at the deliberations of policy shaping enables him not only to carry out the expressed determinations but also to interpret and be guided by the intent behind them.

It is the responsibility of the executive director to prepare a budget for approval of the board. This would include an estimate of income and an estimate of expenditures which, when approved by the board, becomes the authority for the director to make such expenditures. Fund raising is primarily a responsibility of the board, but the director should be expected to help foster relationships in the community that will help the board in this endeavor.

The board must be helped to realize that the responsibility of the director to

the patient is a vital one and second only in importance to the relationship of the physician to the patient. Both legally and morally the patient places himself in the hands of the center, as personified by the executive director, with implicit faith that everything for his safety and proper care will be provided.

The director is obligated to the staff members to provide and maintain facilities, equipment, and assistance in order that they may carry out their responsibilities to the patient with the greatest of ease and efficiency.

The executive director should have authority to employ, direct, discipline, and dismiss personnel. This should be accomplished in collaboration with the medical director and department heads, in accordance with written rules, regulations, and outlines of employee duties. In his relationships with employees, he must realize that they may reasonably expect that he has a responsibility to provide them with a framework of organization and proper physical facilities in which they may carry out their assigned duties. He must be ever cognizant of their needs and must coordinate and correlate their efforts. He must provide them with decent working conditions, see that they are adequately compensated, and furnish an incentive for increased efficiency. To do a good job, the staff must be convinced that it is worthwhile.

The duties of the executive director cannot be limited to the walls of the center. Centers are maintained by communities so that they may have the rehabilitation service they need. In order to provide this service it is incumbent upon the director to ascertain that methods employed are keeping pace with the new developments in the field generally. The board should insist that he cooperate with other community agencies, participate in local and national organizations that are constantly striving to improve services, and bring back for his own center the progressive ideas that are developed. He is expected to assist and provide leadership in community efforts toward better rehabilitation for the disabled. He must also be able to interpret the role of the center and the worth of rehabilitation to various groups and should be able to talk and write convincingly as the center will be judged by the impression he makes in public or written statements. His affiliations with national, state, and local organizations will lend prestige to the center if he carries out these responsibilities capably.

All of the foregoing constitutes much to be asked of any one person and such total competency may be found in few individuals; however, on every board and in every community are resources that may be tapped to assist the director in many areas such as finance, accounting, law, and public relations. He need not be an expert in all these fields to operate a center efficiently, but if he is to utilize and correlate all of these resources available to him, he must have certain basic qualities. He must have a deep understanding of and appreciation for the principles and philosophy underlying the rehabilitation of the disabled and a wide knowledge of the skills and technics necessary to achieve the best rehabilitation possible.

He should have the desire to help others; he should be always mindful that the entire center revolves about the patient and that the patient's welfare comes first. Understanding of people and of people's needs are, therefore, requisites.

The executive director should be an emotionally mature and stable person since the major portion of his time involves work with other people — the board, committees, the staff, patients, and community groups. He should possess the ability to attract people and to inspire their confidence and loyalty. He must have such qualities as initiative, patience, loyalty, sense of fairness, leadership, and willingness to accept criticism, particularly, constructive criticism. A sense of humor helps — none can afford to take himself too seriously.

A business organized for profit would, perhaps, best be served by a single executive with a great deal of authority, but an organization set up with service to the community as a principal object must deal with the general public with a more subjective and understanding approach. The policies cannot be as arbitrary as in a profit organization. Usually the ad-

ministrative pattern of the center is determined by the obvious fact that community financial supplementation is essential. In order to stimulate this supplementation, actual participation by influential citizens at the policy making level of the center is necessary.

Four major elements comprise the administrative structure of a center: the board of directors, the medical director, the chief executive officer, and a departmentalized personnel with a competent head of each department. Such a structure offers several challenges to good organization and often the needs of the patient require some sacrifice of administrative efficiency, for the center is primarily a service organization. Good management then must be attuned to the philosophy of rehabilitation, to the physical and emotional care of patients, to the psychology of personnel relationships, and to the economic and cultural pattern of the community.

Observations of Neck and Shoulder Girdle Muscle Action. Dorothy M. Dean. Phys. Therapy Rev. **36**:112 (Feb.) 1956.

Muscle function was studied in a patient who had recently undergone a radical neck dissection on the right. During the surgery the sternocleidomastoid muscle on the right was removed, the spinal accessory nerve was cut, and the dorsal scapular nerve was injured. Because of these nerve injuries there was no function of the trapezius and there was severe weakness of the rhomboids on the right. Pictures of the patient's shoulder during various motions accompany this article and show well the levator scapulae and rhomboid muscles.

Physical therapy consisted of luminous infrared, light massage to the face and neck, active and passive stretching of the contractures present, and active exercises of the head and shoulder. Three months after surgery and one and one-half months after physical therapy was started it was noted that there was no marked abnormality of function of the shoulder. The arm could be elevated in the frontal and sagittal planes through 170 degrees. Functional motions which showed the greatest handicap were scapular retraction and elevation power. The levator scapulae though hypertrophied maximally could provide only minor assistance in retraction and elevation.

The patient was able to use the extremity well. Lifting heavy weights was very tiring. The patient was able to cast with a fly rod while fishing for two hours without tiring.

Pectoralis Minor Tenotomy and Anterior Scalenotomy with Special Reference to the Hyperabduction Syndrome and "Effort Thrombosis" of the Subclavian Vein. J. W. Lord, Jr., and P. W. Stone. Circulation **13**:537 (Apr.) 1956.

Five cases of the hyperabduction syndrome are presented. Neurovascular compression occurs following repeated or prolonged hyperabduction of the arms at the primary site at which the vessels and nerves emerge from beneath the pectoralis minor tendon. A secondary site of compression is the interval between the clavicle and first rib. Pectoralis minor tenotomy and anterior scalenotomy were done with gratifying results in four out of five patients. Three of the successful cases presented a thrombosis of subclavian or axillary vessels. The unsuccessful case was felt to be due to a combined hyperabduction-costoclavicular syndrome in which primary claviculectomy would have afforded a more satisfactory result. Cervical rib, hypertrophic anterior scalene muscle and a narrowed space between clavicle and first rib must be differentiated from the true hyperabduction state.

Financial Arrangements for the Practice of Physical Medicine and Rehabilitation

Oscar O. Selke, Jr., M.D.
Houston, Texas

A survey was made in June, 1955, to determine how physical medicine and rehabilitation was being practiced in the United States in regard to business arrangements. The purpose was to acquaint physiatrists with trends in methods of practice, and to provide such information to physicians interested in entering the specialty. The findings in this survey should not be interpreted as representing any ideal method of practice, but only as reflecting existing methods of practice.

The survey was made of the diplomates of the American Board of Physical Medicine and Rehabilitation as listed in the 7th edition of the Directory of Medical Specialists. This group was chosen in preference to membership of the American Society (now Academy) of Physical Medicine and Rehabilitation because it comprised a larger group. It was chosen in preference to membership of the American Congress of Physical Medicine and Rehabilitation because many Congress members do not practice primarily physical medicine and rehabilitation. The survey was aimed at physicians who were primarily interested in this specialty and who were attempting to fashion their practices around the peculiarities of the specialty.

A total of 228 questionnaires was sent out; 173 were returned — a percentage return of 76 per cent. Five questionnaires returned could not be used in compiling the report. Some questionnaires contained answers to one or more questions that were not counted because of improper marking.

Summary

Salaries and private fees were the popular types of financial arrangements. Only 12 per cent of physiatrists had percentage arrangements with hospitals, and such income amounted to only 5 per cent of the total national income of physiatrists. In most hospital arrangements, the hospital owned the equipment and paid the therapists; but in 33 per cent of hospital arrangements, patients were billed either by the physiatrist or in the physiatrist's name.

Sixty-five per cent of the national income of physiatrists was derived from salaries, with 82 per cent of physiatrists deriving all or part of their income from salary arrangements. These figures were not weighted by a predominance of replies from the Armed Services and Veterans Administration. A check-back showed that 27 per cent of physiatrists were in the Armed Services and Veterans Administration, and that 26 per cent of replies received were from this group.

Eighty-four per cent of physiatrists devoted 100 per cent of their practice to physical medicine and rehabilitation; 54 per cent reported having income from private fees, but only 12.5 per cent derived their entire income from private fees; 38 per cent maintain private offices separate from any hospital affiliation.

The following charts represent the survey results:

Percentage of Physiatrists' Practice Devoted to Physical Medicine and Rehabilitation

Percentage of Practice	No. of Physiatrists
20%	2
50%	4
60%	1
70%	4
80%	5
90%	10
100%	140

Number of Physiatrists Whose Professional Income Includes:

Private fees	90
Salary arrangements	
Percentage arrangements	20

Number of Physiatrists Whose Professional Income Consists of:

Private fees only	21
Salary only	68
Percentage arrangement only	1

Breakdown of Proportionate Sources of Income of Physiatrists

% of Income	Private Fees, No.	Salary, No.	Percentage Arrangement, No.
10%	16	7	5
20%	10	7	2
30%	8	5	4
40%	5	4	1
50%	12	14	2
60%	4	4	2
70%	3	7	3
80%	5	9	0
90%	6	11	0
100%	21	68	1

Arrangements of Percentage Division of Receipts

Percentage Division	Number of Physiatrists* Based on Gross Receipts	Based on Net Receipts
10-29%	6	2
30-39%	5	...
50-59%	3	8
70-79%	...	1

*Two physiatrists reported having combination salary-percentage arrangements with hospitals.

Mode of Private Practice	No.
Individual Proprietorship	70
Partnership	4
Group practice	13

Source of Patients in Private Practice	No.
Referred from other physicians only	44
Accept without physician referred	37

Type of Private Practice	No.
Consultation only	6
Consultation and Treatment	64

Of the Physiatrists Reporting Income From Private Fees:

60 maintain a private office separate from any hospital affiliation.

32 do not maintain a separate office.

Hospital or Clinic Physical Medicine and Rehabilitation Depts.

	By Physiatrist	By Hospital	By Physiatrist and Hospital
Equipment Ownership	6	103	4
Paying of Therapists	6	103	4
Billing of Patients	27	75	10*

*By physiatrist through hospital.

VA, Military, and Government Hospitals not included in above.

Number of Hospital PM&R Departments Physiatrists Direct

No. of Hospitals PM&R Depts each directs	Physiatrists, No.
0	13
1	76
2	45
3	17
4	3
5	3

Distribution of Physiatrists in Full Time Positions

Where Employed	No.
Private hospitals or clinics	28
Local and state government institutions	4
Veterans Administration	35
Armed Forces	8
Teaching	6

Total National Income of Physiatrists

Questionnaire Sent To Physiatrists

These Simple Questions Will Take You 1½ Minutes to Answer

1. What percentage of your practice is devoted to Physical Medicine and Rehabilitation?

Circle: 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. Under what financial arrangement do you practice PM&R?

	Per Cent PM&R Income (circle)									
Private Fees	10	20	30	40	50	60	70	80	90	100%
Salary	10	20	30	40	50	60	70	80	90	100%
Percentage Arrangement	10	20	30	40	50	60	70	80	90	100%

3. If you receive a percentage division of receipts, what is the arrangement?

	What Percent (circle)
Based on gross receipts. _____	10-29
Based on net receipts. _____	30-39
	40-49
	50-59
	60-69
	70-79

4. If you direct a hospital or clinic PM&R facility: (circle)

Who owns the equipment?	The physiatrist	Hospital	Both
Who pays the therapists?	The physiatrist	Hospital	Both
Who bills the patients for services rendered?	The physiatrist	Hospital	The physiatrist thru the hospital

5. In how many hospitals do you direct PM&R depts.: (circle) 0 1 2 3 4 5

6. Do you maintain a private office for PM&R separate from any hospital affiliation?

_____Yes _____No

7. If you are in active private practice is it _____As an individual proprietor, _____In partnership, _____In group practice.

8. In your private practice, do you take patients: _____Only on referral from other physicians, _____Without referral, _____Consultation only, _____Consultation and treatment.

9. If you are not in private practice, are you:

_____Full time in a private hospital or clinic.
_____Full time in a local or state government institution.
_____Full time with the Veterans Administration.
_____Full time with the armed forces.
_____Full time teaching.
_____Full time medical research.
_____Full time industrial.
_____Other full time _____

Clinical Analysis of Static and Dynamic Patterns in Cerebral Palsy With a View to Active Correction

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and
P. Plum
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Cerebral palsy may be defined as a disease characterized by chronic dysfunction of the neuromuscular apparatus caused by an inactive brain lesion and frequently combined with other cerebral dysfunctions. This definition excludes tumours, inherited and embryogenetic lesions of the encephalic part of the central nervous system, and diseases that affect the spinal cord, peripheral nerves, muscles, and supporting apparatus. Although this is a compromise between an etiological and a symptomatological definition, it has certain clinical advantages as regards diagnosis, prognosis, and treatment.

Since the brain lesions vary widely in localization and extent,[1, 2] the degree and nature of the symptoms of the deficiency differ considerably. The symptoms may involve the muscular apparatus alone or other areas, such as speech, vision, hearing, and intelligence, according to the location of the lesion. The impaired function of the nervous system manifests itself by malfunction of the muscular system,[3, 4] such as spasticity, rigidity, athetosis, tremor, and ataxia. Any one of these symptoms may be present or they may be in combination. This discussion deals chiefly with spasticity.

A spastic muscle is characterized by hyperexcitability.[5, 6] This is manifested by exaggerated tendon reflexes and increased tonus when there is contraction of the antagonist, and it contracts in response to passive extension ("clasp-knife" phenomenon). Electromyographic studies of the spastic muscle indicate increased excitability, irradiation, and synchronization.[7] The ability to do voluntary contraction is reduced. This results in decreased strength, muscular atrophy, and reduced speed of selective and coordinated movements.

With such functional disturbances of the neuromuscular systems, a patient with mild to moderate spasticity of the muscles is able to perform most voluntary movements with reduced strength and varied excursions. Whether and how a movement can be performed depends on whether the movement is to start from some abnormally altered posture or position or from a corrected one. In our opinion, this is a factor of great importance in order to understand and treat dyskinesia.

The primary cause of these disturbances in dynamic function is an abnormality of the cortical and presumably the subcortical function.[8] As a result, the innervation of the anterior horn cell is not integrated in the normal way, especially in regard to the total effect of the proprioceptive impulses. The reduced inhibition of the proprioceptive impulses exerts a different effect on the various muscle groups, depending on their strength and on the degree to which their function maintains posture. The more a muscle group is engaged in counteracting gravity, the more developed is the function of its proprioceptive apparatus;[5, 6, 9, 10] consequently, it will respond more to stretching.[11]

The aim of treatment should be restoration of the defective function by long-term utilization of the total ability of the patient. This difficult task is complicated by children being presented for treatment too late and because the numerous therapeutic measures often are not coordinated.

The possibilities of treatment are active restitution of function of the neuromuscular apparatus by exercises; prevention and correction of contractures

From the University Clinic of Pediatrics, Rigshospitalet, Copenhagen.

by conservative mechanical devices; instruction of various kinds, such as speech therapy, schooling, psychotherapy, occupational therapy, and general and vocational education; ophthalmological therapy; drug therapy; neurosurgery; and orthopedic treatment of neglected cases. The first four possibilities named are of the greatest significance. The use of drugs and neurosurgery is still in the experimental stage.

Active restitution presupposes a detailed knowledge of the function of the neuromuscular apparatus. The treatment must be varied according to the nature and severity of the symptoms. This may be exemplified by the following description of the analysis and treatment of a subgroup, spastic paraplegia.

Analysis of Static and Dynamic Patterns in Spastic Paraplegia

Paraplegia is characterized by certain postural alterations. The standing posture is characterized by equinus of the foot in a valgus position, flexion of the knee and hip, and increased pelvic inclination and lumbar lordosis. In addition, there will be adduction and inward rotation in the hip and, in severe cases, a valgus position of the knee (figs. 1 and 2). These postural alterations are maintained or accentuated while walking. The forward movement of the stepping leg is made possible by leaning the trunk to the opposite side in an attempt to elevate the pelvis; but in spite of this elevation, the toes do not clear the floor entirely (fig. 3). The waddling gait produced is similar to that seen in patients with bilateral dislocation of the hip. The symptoms are less striking in patients with mild cases while standing or walking, but are accentuated while they are running and are very apparent in a slow-motion film. (Filming is an indispensable supplement in evaluating and noting progress of the patient, as emphasized by Bronson Crothers.[12] The patient has difficulty in standing on one foot, and generally he is unable to hop on one leg.

The stretch reflexes are exaggerated. These generally include a marked ankle clonus, exaggerated Achilles tendon reflex, and exaggerated patellar reflexes, with an extended reflexogenic zone, after-contractions, and crossed adductor reflexes. The Babinski and Gonda's sign are positive. As a rule, the abdominal and tendon reflexes in the arm are normal. The sensibility and postural sense usually are not decreased.

Elicitation of the stretch reflex de-

Fig. 1 — Spastic paraplegia in a boy aged 12 years.

Fig. 2 — Same patient. Note the inward rotation of the thighs and the upward displacement of the patella.

Fig. 3 — Same patient walking.

pends upon many factors, such as the child's emotional state, preceding function of the involved muscles, and their starting position.[10] Furthermore, it is difficult or impossible to elicit the stretch reflex if the movement is carried out slowly at the onset. This also applies to the use of the antagonists when the rate of contraction is slow. Adduction and flexion contracture in the hips are frequently present; the latter usually is more marked. There is a stretch defect in the knees, with considerable upward displacement of the patella and outward rotation of the tibia. Passive dorsal flexion of the ankle is decreased. Dorsal movement of the foot accentuates the valgus position. When force is employed, the calcaneous remains stationary, the movement taking place in the forefoot. During this movement the longitudinal arch of the foot may become inverted (convex sole, fig. 3).

The time factor in movement differs from normal[7] in that starting of the movement is slower and the duration is longer. These factors are of significance in coordination of associated movements, such as walking.

A child with paraplegia (or a patient with some other form of spastic paralysis of the lower limbs) who has not learned to stand will assume a posture determined by the synergistic disturbances, usually lying with adducted hips, extended knees, and talipes equinus. At an early age, the postural alteration of the hip and muscular imbalance predispose the patient to coxa valga and subluxation. If the child learns to stand and walk without correction of the adductor contractures, the deformities will be increased.

The aforementioned characteristic posture is due to the overaction of the antigravity muscles and secondarily to the changes in posture necessary to maintain balance. Owing to the talipes equinus, the supporting structures of the body are moved forward; in order to maintain balance, the center of gravity of the body has to be moved forward correspondingly. Normally, this is effected by dorsiflexing the ankle, but the talipes equinus prevents a paraplegic subject from doing this; therefore, he moves the center of gravity forward by flexing at the hips. Then, in order to maintain the vertical posture of the trunk, he has to increase the lumbar lordosis. The increased pelvic inclination lengthens the distance between the attachments of the hamstring muscles, increasing their flexory component on the knee joint. On the anterior aspect of the thigh the attachments of the rectus femoris will approach each other, reducing their extensory power. The talipes equinus increases the activity of the gastrocnemius as a flexor of the knee. These factors enhance flexion of the knee, which may lead to contractures. The deformity of the leg and foot results because, for purposes of equilibrium, the supporting base has to be widened by moving the feet apart. Owing to the adductor spasm, this can be done only by inward rotation of the thighs, which forces the lower legs into the posterolateral direction, whereas the knees remain together. Accordingly, the weight rests on the anterior part of the medial border of the foot, resulting in pronounced pes valgoplanus. If this posture is not corrected, the pseudovalgus position of the knee may become fixed (figs. 1 to 3).

Length of the muscles is affected by

the postural alterations. The abnormal functional position of the lower extremities will result in gradual shortening of the adductors, the rectus femoris, and the muscles of the calf, and lengthening of the antagonists, which may undergo atrophy.[13] A characteristic sign of the shortening of the rectus femoris is the upward displacement of the patella (fig. 2) and is presumably associated with degeneration of the patellar ligament.

The ability to perform a given, isolated movement depends on the position of the involved extremities. If the postural deformity is corrected manually, the ability to do voluntary movements and the strength to do the movements are reduced or lost. Sometimes the patient cannot perform an isolated voluntary movement even if he is left in his usual position. This is due to loss of ability to do selective movement of a given group of muscles, unfavorable mechanical conditions, or a combination of these factors.

Undoubtedly the reason that the starting position is important is that a spastic child has to change the congenital patterns of associated movements. A normal child will gradually learn to hold his head up, sit, creep, stand, and walk without any help or guidance because his motor development follows an anatomical and chronological differentiation of the nervous system; on the other hand, a spastic child is unable to develop normal dynamic patterns. Therefore, he has to substitute abnormal movements, partly because of the destruction of neurons and partly because of the postural alterations caused by the spastic muscles. These are primarily the spastic antigravity muscles. In spastic paraplegia with postural alterations of the hip, knee, and ankle, the dynamic and the corresponding neuron patterns have to develop on this basis, that is, the impulses have to pass along other tracts than normal.

We have worked out a technic for analyzing the dynamic patterns in cerebral palsy. In spastic paraplegia, the patient's capacity to perform given, isolated movements in a characteristic manner, which is of diagnostic importance, depends on the posture of the involved extremity. The ability and power to do voluntary movements is reduced during manual correction of the postural deformities.

The ability to extend the lower extremity is reduced or lost if the patient is placed in a prone position with the knees together and extended and with pressure applied over the sacrum to correct the flexion contracture. This finding is probably due to passive stretching of the soft tissues of the anterior aspect of the hip and thigh. When asked to flex the knee from the same starting position, the patient can do so only with difficulty or not at all. When the pressure on the sacrum is stopped, the patient can perform the flexion easily, but only by simultaneously flexing the hip. The inability to perform the voluntary flexion of the knee is not due to mechanical factors, since the patella remains free in the starting position. Spasticity reappears in the quadriceps and counteracts the movement when a mild, variable degree of flexion occurs. In the same starting position with the knee flexed to a right angle, the patient's ability to rotate the hip and thigh and dorsal and plantar flexion of the foot is abolished or reduced. The possibility of a mechanical obstruction to rotation of the hip may be excluded by letting the patient perform the movement from an accentuated abnormal position. Plantar and dorsal flexion of the ankle is weak or cannot be performed as an isolated movement. The weakness of plantar flexion may be due to incompetence of the gastrocnemius when acting from the spontaneous intermediate position. In the supine position with the hip and knee flexed to a right angle and with thighs in extreme abduction, the power of adduction is often only slight. When the thigh is in the midline, the power may be abolished. Similarly, in these positions the power of abduction is reduced.

The foregoing is a description of the typical findings in spastic paraplegia in which the spasticity involves the adductor group, the quadriceps femoris, and the triceps surae, particularly. Owing to individual variations, however, a detailed analysis is required in each case. Dyskinesia of similar nature may be shown in

the upper limbs by the same diagnostic technic.

Therapeutic Deductions

On the basis of what has been stated, active restitution of the neuromuscular function must be directed toward reestablishing the innervation of the anterior horn cell, attaining more nearly normal muscular function, and preventing and correcting postural deformities and contractures.

The neurons in the brain that have been destroyed cannot regenerate, but there is reason to believe that the function of damaged neuronal systems may be partially restored, retraining intact neuronal pathways.

The muscular changes in cerebral palsy appear gradually and increase if effective treatment is not instituted. The outstanding changes are the paralysis or weakness of voluntary movements and increased tonus, resulting in decreased coordination, atrophy, and contractures of muscles, tendons, ligaments, and joint capsules.

The changes in the muscles and fascia produce postural deformities and secondarily, contractures of the hip joint that may be complicated by subluxation or dislocation. A factor of decisive importance in correcting abnormal length of muscle is that the resting length of muscle can be altered according to the habitual position in which it functions. The connective tissue of the muscles is altered in the following way: If, over a long period of time, the muscle functions in a shortened position, the connective tissue adjusts to this length, thus shortening the resting length of the muscle and vice versa. The length of the connective tissue determines the degree of passive extension.

Another factor of therapeutic significance is that, like neuronal tissue, striated muscle cannot regenerate; however, if atrophy of muscle has not progressed to the point where the nuclei and sarcolemma have disappeared, there is a possibility of increasing the function of the muscle. The effort to obtain active restitution of function must be an attempt to reestablish simultaneously cerebral innervation and increased muscular power, since the neuromuscular system is a functional entity.

We believe that it is important to train the spastic muscles. Although these muscles always have less than normal power, owing to the spasticity, they tend to overpower their antagonist. The spastic muscle must be trained in order to increase cerebral control as well as to increase its strength. As the patient is gradually able to perform consciously definite or isolated movements, the cerebral inhibition may be increased and the spasticity consequently decreased.

One of the first procedures in our treatment of paraplegics is to determine the child's ability to perform movements necessary for normal walking. Usually he is able to innervate all of the groups of muscles to a certain extent when he is permitted to start with his characteristic posture. The movements may be facilitated by letting the patient perform associated primitive movements.[10, 14, 15]

The patient is taught to innervate selectively muscles that are necessary for normal walking, such as simultaneously extending the hip, flexing the knee, and dorsiflexing the foot. In the prone position the patient is asked to concentrate on performing the following voluntary movements: Lifting each leg separately, the knee extended (in order to perform this movement the patient flexes the contralateral hip and turns the trunk to the opposite side, fig. 4); bending his knee (which he can do only while simultaneously flexing the hip); with flexed knee, moving the foot up and down (which involves simultaneous flexion of the hip, fig. 5); and, with the knee flexed, inward and outward rotation of the femur (he usually is unable to perform these movements and substitutes adduction of the hip and rotation of the trunk). After making sure that the patient understands which movements he is to perform, the operator must then passively extend the patient's hip by pressing upon the sacrum and help the patient perform the following movements.

Extension of the Hip with Extended Knee: The operator puts his hand under

Fig. 4 — Same patient trying to perform unilateral extension of the hip.

Fig. 5 — Same patient trying to perform isolated flexion of the knee.

the knee and supports the movement while encouraging the patient to contract the muscle. Other movements should be assisted and guided in the same manner. As the patient gradually learns to innervate the individual muscle groups, the exercises are carried out with suitable resistance, using loads of known weight.

Adduction and Abduction of the Hip: The patient is placed in the supine position with hip and knee flexed. He is asked to spread his thighs as far apart as possible and to adduct as forcibly as possible against unyielding resistance offered by the operator. After a short rest, this is repeated.

"Up- and Downhill" Exercise: Since the triceps surae is of predominant significance to the postural alterations, particular attention is paid to its training. The "up- and downhill" exercise is an example of the methods we use. The "hill" is made by a board, about 2 m. (6½ ft.) in length and 40 cm. (15¾ in.) in width, with an inclination of 20 to 30 degrees. The patient is asked to walk up the board with knees and hips extended, being sure the heels touch the board on each step. He must learn to take short steps and keep his heels down. He walks down the board backwards. At intervals he is made to stand on tip toes. Another exercise is for the patient to stand with his back against a wall with his feet on a wedge sloping towards the wall. In this position he is made to raise and lower his heels. When this exercise can be done satisfactorily, an effort is made to develop coordination of the movements and to increase the speed at which they are done.

Other Exercises: Other more or less specific exercises may be used, such as dorsiflexion of the foot against resistance, flexion and extension of the knees, walking on the heels, walking on tiptoes, walking with outward rotation of the feet, walking on the lateral border of the foot on a triangular board, swinging the legs, and raising the trunk in the supine position with flexed knees (to counteract the pelvic inclination).

An often discussed problem is whether a spastic patient should be allowed to do improper movements in a relatively effective way. In our opinion, the primary aim in training the spastic patient is to try in every way possible to teach the correct movements. If this requires such a prolonged period as to inhibit the development of the patient in other ways or if it does not appear practicable, one must aim at a dynamic pattern as close to normal as possible.

Summary

The pathophysiological mechanism of cerebral palsy is roughly outlined. A few static and dynamic patterns in paraplegia are analyzed. A method to demonstrate the impaired capacity for selective movements is described. It is demonstrated that the ability to perform voluntarily the components of normal, associated movements is reduced or abolished when the postural alteration is corrected passively. This is due partly to reduced innervation and partly to mechanical interference. Our therapeutic aim is to develop selective voluntary movement during manual correction of the postural alteration. Simultaneously or subse-

quently we endeavor to develop coordination and increased speed in voluntary movements. Moreover, it is emphasized that the training must be aimed at correcting existent alterations in muscle length by training the shortened muscles in elongation and vice versa.

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Dilatal in the Treatment of Intermittent Claudication in the Calf Muscles. D. N. Walder. Lancet **270**:257 (Feb. 11) 1956.

Dilatal, a recently introduced medication synthetized from parahydroxyephedrine, has been claimed to increase muscle circulation. It has been used extensively clinically in Germany but few critical tests of blood flow through the muscle have been done.

Fifty-two patients with peripheral vascular disease who presented symptoms of intermittent claudication were given either placebo or Dilatal for an eight to nine week period. The tolerance of the patients was determined prior to discharge home on the new medication.

Plethysmographic studies showed very little change in resting blood flow to the calf but some increase was noted. No significant change was noted in the rate or the amount of work done or in the post-exercise blood flow.

The best subjective results were noted in the patients who had never received any previous therapy, and of significance is the fact that almost 50 per cent of the patients who were receiving placebos reported improvement.

An Evaluation of Some Electrodiagnostic Methods: II. Low Voltage Testing

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This is the second in a series of three papers on the subject of electrodiagnosis; the first of the articles appeared recently.[1]

A hundred years ago Pfluger demonstrated the effects of weak, medium, and strong currents on the production of nerve impulses. This information is taught to all medical students in physiology but many times forgotten by them before they are ready to conduct their first electrodiagnostic test. These phenomena led to the studies of membrane potentials and evolved electrotonus, or the changes in membrane potentials with the passage of an impulse. There is a period during which the nerve is hyperexcitable (catelectrotonus) and a period of depressed excitability (anelectrotonus). These conditions affect successive impulses passing along that nerve.

Studying the effects of direct and faradic current on human nerve conduction led Eulenburg[2] and Erb[3, 4] to the classically accepted definition of electrodiagnostic testing by Erb[5] in 1868. In many clinics, a modification of this test is still the only one used. Licht[6] has compiled a history of the development of electric methods in medicine. Excellent articles reviewing the clinical development of low voltage electrodiagnostic methods have appeared.[7-10]

There are two aspects to the problem of testing muscle that has its nerve supply interrupted; first, the understanding of the normal physiology of the conduction of the nerve impulse, and second, the clinical method of discovering whether normal physiologic and anatomic continuity of the nerve exists. The physiology of the propagation of the wave of depolarization which characterizes the passage of the nerve impulse can be reviewed in any good physiology textbook. From this study, it will be learned that the impulse and its effects are not simple and that much is yet to be determined. It is only theoretically supposed that during the passage of the impulse there is a wave of negativity producing a spike potential. The spike is real, as detected on the oscilloscope, but the properties of the axis cylinder and myelin sheath which produce this wave are not clear. Less clear is the mechanism of the passage of that impulse from the nerve to the muscle via the chemical mediator acetylcholine.

Many factors may elicit a nerve impulse, such as tapping and chemical, temperature, and other changes in the environment of the nerve, in addition to electrically imposed shocks. Likewise, many changes of subliminal intensity may not set up impulses. This property of reaching an adequate change in environment is called accommodation.[11-15] Accommodation was recognized long ago when DuBois-Reymond showed that electric current must have three properties to set up an impulse: a quantity of change great enough to stimulate, application for a long period to allow stimulation, and a rate of change of potential sufficiently fast to change the environment of the nerve.

While these properties were first studied with electrodes applied directly to the nerve, the problem is more complex when the stimulus is applied indirectly through percutaneous electrodes.[16] Skin resistance and tissue fluids, edema, and other substances between the nerve and the outside all have properties of an electric nature that alter the effective

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current reaching the nerve. They have resistance, reactance, and capacitance all of which modify the applied current.[17-19] These factors have complicated the clinical use of the common laboratory types of stimulators such as the inductorium, batteries, condensers, and potentiometers. These pieces of equipment give qualitative results but they are not amenable to reproducible results in quantitative measurements of value to the clinician. While this is only a brief and superficial look at the problem from a physiologic point of view, it should be sufficient to point out the complicated problem confronting the clinician in his quest for a practical method of nerve testing.

To meet the needs of the clinician the equipment should be relatively inexpensive, easy to operate, and capable of producing results that can be obtained time after time with reliability.[18] The results of testing should inform the physician of the status of a lesion — old or recent, partial or complete, degenerating, denervated, or regenerating—and the progress of reneurotization. When the patient is first examined and tested, it should be determined as soon as possible if operative intervention is necessary or if the normal processes of bodily recovery will bring about a satisfactory functional result. When the lesion is complete and the proximal and distal ends are in apposition, spontaneous recovery is likely unless connective tissue intervenes, necessitating surgery. If the lesion is incomplete and some of the nerve fibers are intact, the chances of recovery without intervention are fairly good. If there is no interruption of fibers, such as with pressure degeneration, the necessity for operative intervention is almost always absent. Even if regeneration is proceeding, there might not be enough motor units re-innervated to bring about complete or satisfactory function. In making these determinations the use of electrical equipment has seemed to center as a possible guide to the physician's course of action.

Faradic and Galvanic Stimulation

Since Erb[5] first described the use of faradic and galvanic stimuli for the testing of peripheral nerve injuries, clinical and physiologic research has continued with the purpose of finding a test to meet all the rigid requirements mentioned previously. Faradic current soon was used less in diagnostic work because of its limitations. With relative ease, it would separate the hysterical from the pathological paralysis. The rate of change is so rapid and the duration of application so short that it will stimulate normal nerve and muscle but not injured or denervated muscle when their thresholds are altered. That this is not entirely true was pointed out by Wynn Parry[20] and Arieff.[21] If the faradic current is of sufficient intensity, contraction of denervated muscle can be elicited without too much discomfort or pain. Arieff has shown in the diagnosis of anterior poliomyelitis that as the threshold to faradic current returns from very high toward normal all muscles destined to recover do recover, and all muscles failing to react to faradic stimulation do not recover.

Galvanic, constant, or direct current seems to be the most logical type to use for diagnosis; however, battery or other direct sources of galvanic current are not easily measured in time, rate of change, and intensity. This led to Lapicque's[22] use of condenser discharges to measure chronaxie. Since the discharge of the condenser depends upon the resistance times the capacitance and the product is a function of time, chronaxie was a measure of time. This was an advance because comparisons in nerve injuries could now be measured from one examination to another on a basis of time. Chronaxie is an arbitrary time on the strength-duration curve, defined as being the time of twice the rheobase voltage. It involved finding the rheobase voltage first. The rheobase is the amount of voltage that will cause a visible contraction. This of course is of nebulous quantity itself. The use of condensers had its followers, who were sure of measureable results.[23-25] It was the method of choice in nerve injuries during World War I, although sometimes it was used not for chronaxie alone but as a measure of change in the reaction to the condenser

discharges. Worster-Drought's[24] measurements were in microfarads.

In the interval following World War I, electronics advanced and much work was accomplished along electrodiagnostic lines because now current and voltage could be measured accurately in relation to time. Hill,[11] Grodins,[14] and Osborne[15] studied the effect of alternating currents in producing impulses and contractions. Hill reduced the effect to a mathematical formula that explained accommodation of the nerve to produce or not produce an impulse, depending on the aforementioned time, intensity, and rate of change. Solandt[13] and Pollock[26, 27] essentially repeated the results with condenser discharges and with progressive currents of long duration.

Rectangular and Square Wave Testing

The advent of World War II led to a concentrated effort on the part of clinicians, physiologists, and electrophysicists to produce a convenient and rapid method of handling peripheral nerve injuries encountered during the war.[8] The most concentrated effort came from a group of scientists at Northwestern University working with a group at the Percy Jones Army Hospital.[7, 26-32]

They carefully controlled as many variables as possible and then examined several different tests. First they repeated the work of Erb and found that essentially his description was correct in every detail. They studied the rheobase and found it a good index of denervation and regeneration. Early in the process of denervation there is hyperirritability of the muscle. Rosenblueth[33] attributed this to a release of acetylcholine at the still undergenerated nerve endings at the myoneural junction; however, Pollock[7] found that the condition remained throughout denervation. When a sudden increase in rheobase occurred, it was an indication of reneurotization and preceded all other signs prognostic of clinical recovery.

Strength-duration curves were studied. These curves are those of "accommodation" plus the properties of tissue that require strength of current, time, and sufficient rate of change. The curve has been well known since Lucas' original work and the slope is characteristic for muscle and nerve, but they are not necessarily quantitatively identical. The method of finding all points on the curve was not used by Pollock. Bauwens[16] used only three arbitrary points; Ritchie[17] limited his curves to intervals from 0.01 to 100 milliseconds.

A problem arises with the measuring of current (intensity) as against voltage (strength). While these electrical properties are directly proportional to each other, their physiological properties are different.[18, 19] Bauwens[16] explains that with constant voltage there is a sudden increase in potential but the tissues rapidly produce, through polarization, a back electromotive force that opposes the applied current. This reduces the actual current stimulating the tissue; therefore, it cannot be measured accurately. The time of this build-up also changes, which affects the whole theoretical structure. On the other hand, a constant current is not affected by the back potential, so the maximum can be reached; however, it cannot be reached at once due to the impedance of the intervening tissues. This alters the time of the build-up but not the value of the current setting up the impulse. However, the slope of the curve and its characteristic shape are repeatable experimental facts. During degeneration, the rheobase falls and the slope shifts to the right and becomes steeper. During denervation, the curve remains steep with a low rheobase takeoff. As reneurotization occurs, the rheobase rises suddenly and the curve tapers off less steeply and shows interruptions in its continuity. These interruptions, referred to as "kinks" by Wynn Parry,[20] were said to be diagnostic of regeneration and thought to be due to advanced neurotization of some of the fibers while others were still to receive their regenerating nerve endings. The "kinks" remained as long as two years after functional, clinical recovery had occurred. Pollock[28] warns that it is not a simple matter of increase or decrease in the strength-duration curve for there are intermediate rises and falls with intermediate troughs. The essential value is in chronologically follow-

ing the activity of degeneration, denervation and, regeneration.

Another test resulting from the work of the Pollock group[29] was the development of galvanic tetanus and the galvanic tetanus ratio. Because of the high degree of accommodation, normal nerve requires four to five times the rheobase strength of current to produce tetanus. This procedure in the normal patient is quite painful and not well tolerated. When applied to degenerating nerve, it is found to require less intensity to produce tetanus. As recovery takes place, the intensity required increases and can be used as a prognostic indicator of regeneration.

To facilitate the expression of this phenomenon, the galvanic tetanus ratio is used. The intensity required to produce tetanus divided by the rheobase intensity comprises this ratio. As stated previously, normally the ratio is 4 to 5. As the ratio decreases to 1 to 2, degeneration is said to be progressing. A repeated ratio of the same quantity with either anodal or cathodal stimulation is an indication of denervation, while an increasing ratio, especially with a suddenly increasing rheobase intensity, is a sign of reinnervation and regeneration.

Doupe[8] has attempted to explain this on a physiologic basis. Two factors seem to influence this response. The first is that denervated muscle develops a repetitive excitation when subjected to electric current and may be explained in part by galvanotonus. The second factor is the relative "cool" state produced by the vascular changes accompanying denervation. Kugelburg[34] has shown that changes produced by either ischemia or a decrease in calcium ions give a similar pattern in normally innervated muscle when it is stimulated. He believes that the impulse originates spontaneously within the affected nerve.

As shown originally by Erb, anodal stimulation tends to approach unity with cathodal stimulation during the process of denervation. The basis for this is that the degenerating nerve and the denervated muscle are more susceptible to any electrical stimulus, probably due to reduced accommodation. Again Pollock[7] was able to reduce this to a ratio of the anodal stimulus intensity divided by the cathodal intensity. This is normally about 2.5 to 3. For years textbooks mentioned that polarity was reversed during degeneration and denervation; however, Pollock's group showed that there never was a reversal but that a ratio of 1 was reached or approached. As neurotization occurred, the ratio increased, although at the time of recovery of voluntary contraction it still had not reached normal.

Normally innervated muscle has a threshold for stimuli from currents of slowly rising intensity (saw-tooth-shaped pulse) as it also does for quickly rising current intensities (square or rectangular waves). This latter threshold is again the rheobase. The ratio of progressive currents is reached by dividing the current of slowly rising intensity by the current of the rheobase. With a loss of accommodation, these two thresholds will tend to be the same, a ratio of 1:1. During regeneration, the ratio again rises and exceeds the normal.[26] Technical difficulties have led to the discontinuance of this test as clinically unfeasible.

The last test in this series of Pollock's is the use of repetitive stimuli on strength-frequency curves.[30, 32] Muscles stimulated by repetitive stimuli of a fixed duration, with only the interval between stimuli being altered, give a characteristic contraction when normal. This is because short subthreshold stimuli modify the excitable muscle tissue for a limited time. A second subthreshold stimulus following the first may be summated and cause an impulse and contraction. This property of facilitation or recruitment is a function of the accommodation. Hill,[11] Solandt,[13] Grodins,[14] and Osborne[15] have pointed out that sinusoidal currents produce this change as well as rectangular currents, since their property to stimulate is a function of the rate of change, the frequency, and the intensity. The latter authors claim that a more effective, less painful type of stimulus produces the same results; however, as a diagnostic procedure, the time and current intensities are more easily

controlled and read by using electronically produced rectangular waves.

During degeneration, threshold amperage increases at all frequencies from 20 cycles per second (cps) upward. The increase is somewhat less from 20 to 100 cps and then much more above 100 cps. With a large constant amperage, there is a falling out of response of effective stimuli at the higher frequencies, first at 5,000 then 4,000 then 3,000 and perhaps 2,000 cps. Later the optimum band of 20 to 100 cps disappears and there is a continuous fall in threshold amperage to 20 cps, and then a gradual fall to 0.75 cps. The discontinuities occur most frequently at 1 to 20 to 100 cps, 100 to 700 to 3,000 cps, and 3,000 to 7,000 cps.

During denervation, the threshold amperage for higher frequencies remains high, but for the low frequencies, 60 cps and below, especially 1 cps or less, the amperage diminishes even more than during degeneration. The optimum band shifts from 20 to 100 cps and down even to 0.08 cps. Then the strength-frequency curve is continuous.

During regeneration, there is a diminution of the threshold amperage from 5,000 cps to 20 cps and an increased amperage in frequencies below 0.75 cps. The curve becomes skewed with two high branches and discontinuity reappears at 700 to 1,000 cps. The acuteness of the angle diminishes progressively. Long after motor recovery, there is a persistent discontinuity at frequencies below 100 cps.

The clinical value of these tests has been discussed by several authors.[9, 20, 35-37] Some have been found reliable while others are of questionable value either due to technical difficulties or to inability of many clinicians to obtain reliable data; however, the fundamental physiologic properties responsible for the results are far from clear. The history of muscle-nerve physiology might easily be the history of physiology. In spite of all the contributions made by famous scientists, there is no simple answer to the nature of the nerve impulse or to those factors that influence this wave of excitation. It would seem prudent, therefore, to accept those clinical tests that can give the most reliable results with the least possible technical skill and look forward to and support further investigation into cause and effect in nerve and muscle conduction.

Discussion

The methods of electrodiagnostic testing that use electrical shocks, deliberately produced and applied so as to bring about excitation of nerve or contraction of muscle, have been used most extensively. Opinions vary regarding their relative merits. Different qualities of the equipment used yield different absolute results so that direct comparisons cannot be made on a numerical basis; however, the pattern of measured qualities is generally very similar, therefore, clinical results can be compared.

The most important finding seems to be to acquire a technical skill with the apparatus being used so that consistent results can be obtained. These results properly used and understood by both the physiatrist and the referring clinician can accomplish the desired end for the patient.

Faradic shocks, under regular precautions, can be of great use as a simple method of determining the integrity of a peripheral nerve. Beyond this, there is some question of its diagnostic value.

The simple Erb's test with galvanic current is a standard testing procedure. Its greatest limitation is the inability to give an early prognosis regarding reinnervation or reneurotization. Where time is of the essence, this test is of relatively little value. Both faradic and galvanic stimulation of these types can be procured with relatively inexpensive equipment.

Chronaxie and the use of the rectangular or square wave low voltage currents are useful aids in the diagnosis of degeneration and regeneration and also indicate the progress of recovery; therefore, they are of more value in the prognosis of recovery and probably more of a guide and timesaver for the neurosurgeon. However, the cost of the equipment and the technical difficulties in obtaining consistently reliable results make

these technics more prone to error and more expensive.

Of all this group of tests the strength or intensity duration curves can probably give the most accurate results, if the pitfalls of technic and the underlying physiological changes are evaluated.

Summary

The use of low voltage shocks to record the integrity of peripheral nerves is discussed. The physiologic and pathologic fundamentals of nerve transmission in their relation to the response to electrical shocks by muscular contraction are presented. The values and shortcomings of the various methods of testing are enumerated.

The elaborate methods used by Pollock and his group during World War II opened a new era in prognosis, which was of help to the neurosurgeon. The relatively inexpensive equipment and facility of obtaining reliable results are both large factors in making low voltage testing a handy clinical tool.

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Associated Reactions of the Upper Extremity in Adult Patients with Hemiplegia. An Approach to Training. Signe Brunnstrom. Phys. Therapy Rev. **36**:225 (Apr.) 1956.

For some time it has been known that in hemiplegics "associated reactions," reflex in nature, appear in the affected limbs when voluntary forceful motions of other parts of the body are performed. The author suggests that maybe a subcortical motion synergy of this type which can be elicited on a reflex basis can serve as a wedge by means of which a limited amount of willed movement may be learned. Probably it is easier to gain control of a motion synergy which is already set up on a lower level than to learn more "cortical" patterns.

Movement synergies which appear as associated reactions are rather uniform in all patients, at least as far as the proximal joints are concerned. Components of the "flexion synergy" which occur most frequently are retraction of the shoulder girdle, abduction and external rotation of the shoulder, flexion of the elbow and supination of the forearm. Components of the "extension synergy" found to be relatively consistent are protraction of the shoulder girdle, adduction and internal rotation of the shoulder, extension of the elbow and pronation of the forearm.

Twenty-six adult patients with hemiplegia were tested for associated reactions. They were tested in the supine position. Resistance to voluntary motion was given on the unaffected side. Some of the strongest components of the flexion and extension synergies were chosen as the voluntary motions of the unaffected side to be resisted. Strong resistance to elbow flexion ("resisted pull") was used. Also resistance to extension of the elbow, pronation of forearm, adduction and internal rotation at the shoulder ("resisted push") was used. The associated activities of these patients when this "resisted push" was applied and when a "resisted pull" was applied were studied with the head in each of the three following positions: head in neutral position, head rotated toward the affected side, and head rotated toward the normal side.

Typical flexion and extension synergies as described in the past by Simon were observed. A flexion synergy in the upper extremity was more easily elicited than an extension synergy. The position of the head when it was in other than the neutral position affected the associated reaction in most cases. In the upper extremity with one exception only a "resisted pull" facilitated a flexion synergy ("pull") of the affected limb and a "resisted push" facilitated an extension synergy ("push") of the affected limb.

Flexibility Characteristics of Males Ten to Eighteen Years of Age

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An instrument and technic for measuring range of joint motion have been presented in a previous article.[1] Both the instrument and technic described were used to collect the data reported here. This study was undertaken as a means of establishing a basis for comprehensive and comparable studies of flexibility. This study sought to identify possible significant age level flexibility characteristics among 10, 12, 14, 16, and 18-year-old males.

Collection of Data

The subjects selected were limited to boys between 10 and 18 years of age who were attending school. There were two reasons for so limiting the data collected. First, subjects in this age range would be growing toward maturity and should be expected to show some evidence of changes that might occur because of physical growth; second, groups in this age range can be found readily at some level of school attainment, hence controls over the group important for measurement purposes would be present. Subjects from older groups would be difficult to obtain and their measurement difficult to control. Also, their varied occupations and skills might influence flexibility to important degrees. All subjects up to and including the age of 16, except for a few wide deviates, could be expected to be attending school at these ages.

In selecting the subjects it was felt that elimination of overlapping abilities might be effected to some extent by narrowing the age range for each group. This was done by counting as of a given age only those boys who were within 3 months of the exact age indicated. This practice, together with the selection of groups 2 years apart, was expected to make more clear-cut any differences in ability that might be present. In each group all of the subjects were measured who were present at the time of measurement; absentees were measured as available until the round number used was reached. No warm-up exercises were given, but all subjects were measured at room temperatures of 72 F. after they had been subjected to that temperature in regular class periods.

Analysis of Data

Analysis of all data was made by comparison of the differences between means. The analysis was made by first determining the means and standard deviations for each of the groups to be studied. Where differences between the means were used, the significance of these differences was found by rejecting the null hypothesis at the 5 per cent level. The Pearson product moment correlation between a first and a second measurement taken consecutively during the measuring period was computed. Reliability coefficients so found ranged from 0.901 to 0.996.

The data are presented in table form so that an over-all picture of flexibility characteristics from age group to age group within these age ranges may be obtained. Table 1 presents the means and standard deviations for the five age groups. Table 2 presents the t values between the various age groups with a + or — preceding this value to indicate the direction (increase or decrease) the measurement takes. The deviation and t values for the total age range of 10 to 16 years are also presented in this table.

Summary of Analysis of Age Groups

From table 2 it is evident that trends are present in particular flexibilities for the boys in this study. They may be classified into four groups according to

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Measurements of the California and Oregon groups were taken by Joseph Forbes and Kenneth Moore respectively.

the direction and significance of each trend.

Group 1 includes those flexibilities that show a significant increase from age 10 to age 16 and those that show a constant increase between all age groups or a constant increasing trend with no significant variations. Shoulder flexion and extension and hip adduction and abduction fall into this group.

Group 2 includes those flexibilities that show a significant decrease over the 6-year period and those that show a constant decrease between all age groups or a constant decreasing trend with no significant variations. The flexibilities that fall into this group are neck lateral flexion and rotation, shoulder rotation, radial-ulnar supination and pronation, wrist flexion and extension, wrist ulnar and radial flexion, hip rotation, and ankle inversion and eversion.

Group 3 includes those flexibilities that show a significant decrease over the 6-year period but show no constant trend and contain variations of probable significance. The flexibilities that fall into this group are shoulder adduction and abduction, trunk rotation and lateral flexion, and elbow, hip, knee, and ankle flexion and extension.

Neck flexion and extension, group 4, shows no significant change over the age period covered.

Validity of Data

Data comparable to those presented were collected for age groups separated geographically from the California group. These data were collected from 12, 14, and 16-year-old boys in the Ontario, Oregon public schools. The conditions under which these data were obtained corresponded closely to the conditions under which the California data were obtained.

The results obtained from the Oregon

Table 1: Flexibility Means for 10, 12, 14, 16, and 18-Year-Old Boys.

Test	Age, Yr.: / No. Tested:	10 / 100	12 / 50	14 / 100	16 / 50	18 / 100
Neck		o	o	o	o	o
Flexion-extension		126 ±18	138 ±13	131 ±11	123 ±12	127 ±15
Lateral flexion		97 ±12	97 ±9	92 ±12	88 ±10	98 ±17
Rotation		177 ±19	162 ±16	159 ±11	158 ±12	159 ±22
Shoulder						
Flexion-extension		241 ±16	247 ±12	247 ±14	258 ±10	236 ±19
Adduction-abduction		185 ±10	181 ±7	184 ±12	173 ±9	177 ±14
Rotation		181 ±12	179 ±14	175 ±10	170 ±15	171 ±17
Elbow						
Flexion-extension		150 ±9	145 ±8	147 ±11	142 ±7	149 ±11
Radial-ulnar						
Supination-pronation		194 ±16	188 ±12	181 ±16	162 ±11	168 ±18
Wrist						
Flexion-extension		168 ±15	145 ±15	137 ±19	131 ±14	126 ±14
Ulnar-radial flexion		92 ±12	87 ±11	78 ±8	76 ±10	84 ±13
Hip						
Extension-flexion		70 ±12	57 ±14	65 ±19	55 ±13	66 ±15
Adduction-abduction		52 ±10	58 ±8	59 ±11	63 ±14	53 ±9
Rotation		111 ±17	81 ±14	71 ±10	69 ±13	92 ±22
Knee						
Flexion-extension		145 ±13	149 ±6	138 ±9	136 ±13	132 ±10
Ankle						
Flexion-extension		81 ±11	61 ±9	57 ±7	63 ±10	64 ±10
Inversion-eversion		49 ±9	47 ±9	44 ±11	43 ±8	45 ±13
Trunk						
Lateral flexion		102 ±11	87 ±10	88 ±9	96 ±15	101 ±18
Rotation		145 ±8	148 ±9	149 ±13	129 ±10	126 ±17

group were compared with the results of the measurements of the California group to find whether discrepancies appeared that would cast doubt because of lack of control in sampling. If no important discrepancies occurred, it could be considered evidence in favor of the significance and validity of the data obtained by the methods used in this study.

This method of comparison is as follows. The differences between the means at 12 and 16 years were computed for both groups. The statistical significances of the differences between these means were then computed to determine whether the revealed changes in flexibility were changes in the same direction. Finally, the statistical significances of the differences between the means of the two groups were computed to determine whether the final flexibility status of these groups was similar. Table 3 presents these data. In this table t values only are presented since they lend themselves to quick interpretation and show the chief evidence that is important in the comparisons sought.

Examination of table 3 reveals the following important facts. Changes in flexibility take place between the 12-year-old and the 16-year-old Oregon groups. These changes are in the same direction for both the California and Oregon subjects except in ankle inversion and eversion. Among the t values involved in these two tests, only one shows a significance at the 5 per cent level. This is the t value for the difference between California 12-year-old and 16-year-old group means in right ankle inversion and eversion. Finally, when the t values for differences of means between the 16-year-old California and Oregon subjects are compared, these differences are small

Table 2: t Values for Differences and Direction of Differences Between Means of Groups Measured for Flexibility.

Test	Age Group, Years				
	10 & 12	12 & 14	14 & 16	10 & 16	16 & 18
Neck	D t	D t	D t	D t	D t
Flexion-extension	+5.04*	−3.57*	−3.73*	−0.89	+1.46
Lateral flexion	−0.17	−2.82*	−1.90	−4.69*	+4.08*
Rotation	−5.36*	−0.86	−0.50	−7.32*	+0.32
Shoulder					
Flexion-extension	+2.67*	+0.65	+4.57*	+7.44*	−9.17*
Adduction-abduction	−2.93*	+1.82	−6.11*	−7.43*	+2.23*
Rotation	−0.94	−2.51*	−1.81	−5.25*	+0.16
Elbow					
Flexion-extension	−3.47*	+1.82	−3.99*	−5.75*	+4.66*
Radial-ulnar					
Supination-pronation	−2.55*	−2.69*	−9.27*	−14.67*	+3.24*
Wrist					
Flexion-extension	−9.03*	−4.52*	−0.82	−14.48*	−2.15*
Ulnar-radial flexion	−3.11*	−4.37*	−2.16*	−8.68*	+4.53*
Hip					
Extension-flexion	−5.52*	+2.78*	−3.48*	−6.42*	+4.46*
Adduction-abduction	+4.19*	+0.39	+1.29	+5.14*	−4.75*
Rotation	−12.15*	−4.06*	−1.06	−17.86*	+8.37*
Knee					
Flexion-extension	+2.37*	−6.57*	−2.37*	−4.27*	−2.28*
Ankle					
Flexion-extension	−11.56*	−3.26*	+3.38*	−9.35*	+1.20
Inversion-eversion	−1.13	−1.54	−0.98	−4.14*	+1.27
Trunk					
Lateral flexion	−8.42*	+0.97	+3.22*	−2.58*	+2.01*
Rotation	+2.29*	−0.08	−10.89*	−10.47*	−0.97

D = direction of deviation from lower age to higher; * = t values significant at the 5 per cent level. Although bilateral measurements were taken in all instances for shoulder, elbow, radial-ulnar, wrist, hip, knee, and ankle flexibilities, t values are given only for the side showing the most significant difference between the means.

except in neck lateral flexion and trunk rotation. Quite important is the fact that in both of these tests the direction of the difference from age group to age group is the same for both the California and Oregon subjects. For neck lateral flexion, the *t* value for the California subjects is —4.39 and the *t* value for the Oregon subjects is —7.72. For trunk rotation, the *t* value for the California subjects is —10.68 and —3.06 for the Oregon subjects.

The trends in flexibility means found in the data collected from the groups of California boys are considered significant trends in flexibility changes in the boys of these ages measured and may be accepted as possible representative trends in general, subject to what further research may reveal. The flexibility status means found for the California 16-year-old group may be accepted as tentative points of reference for comparison with means of other groups, since trends of increase or decrease in ability appear at ages below 16 and evidence of changes in such trends was found in an 18-year-old group.

Flexibility of the Eighteen-Year-Old Group

It was possible to secure measurements of subjects at 18 years of age from students in the Arcata and Eureka public schools, but because of lack of numbers to draw from at the 18-year level, it became necessary to draw part of this group from the Humboldt State College at Arcata.

Up to this point, the changes found in the means of the flexibility tests used and the progressive or static trends found between the means of the 10, 12, 14, and

Table 3: t Values of Differences Between Means of Selected Groups Measured for Flexibility.*

Test	Age Group, Years		
	Calif. 12 vs. 16	Ore. 12 vs. 16	Calif. 16 vs. Ore. 16
Neck	D t	D t	t
Flexion-extension	—6.07	—5.49	0.63
Lateral flexion	—4.39	—7.72	4.32
Rotation	—1.12	—0.83	0.43
Shoulder			
Flexion-extension	+4.49	+4.21	0.33
Adduction-abduction	—4.72	—3.47	0.31
Rotation	—5.46	—2.13	0.16
Elbow			
Flexion-extension	—2.04	—1.36	0.36
Radial-ulnar			
Supination-pronation	—11.19	—9.02	0.58
Wrist			
Flexion-extension	—4.88	—2.75	0.34
Ulnar-radial flexion	—5.39	—5.17	0.49
Hip			
Extension-flexion	—0.62	—0.60	0.51
Adduction-abduction	+2.09	+1.20	0.68
Rotation	—5.67	—3.26	0.14
Knee			
Flexion-extension	—7.04	—4.35	0.81
Ankle			
Flexion-extension	+0.64	+2.59	0.42
Inversion-eversion	—2.41	+0.57	0.99
Trunk			
Lateral flexion	+3.43	+5.42	0.30
Rotation	—10.68	—3.06	3.50

*Although bilateral measurements were taken in all instances for shoulder, elbow, radial-ulnar, wrist, hip, knee, and ankle flexibilities, t values are given only for the side showing the most significant difference between the means.

D = direction of deviation.

16-year-old groups have been presented. The differences between the means for the 16 and 18-year-old groups of subjects have not been mentioned. Preliminary study of the data indicated that from age 10 to 16 those differences and trends of differences presented for the lower age groups did not carry over into the differences between the 16 and 18-year-old groups. Apparently there were significant deviations in the trends already presented in many of the differences between means of the various tests for the 16 and 18-year-old groups.

The fourth column in table 2 gives the *t* value significance of the difference between the means of the various tests for 10 and 16-year-old boys, and shows the direction of these differences. The fifth column shows a wide variation of mean differences and direction of these differences from the conditions pointed out in column four. In other words, the apparent regularity of pattern of differences in flexibility ends at age 16 for these California measurements.

It will be noted that the direction of difference changes for 15 of the 18 tests; 5 of these differences between the 16-year-old and 18-year-old groups are not significant at the 5 per cent level. Thus, for 10 of the tests, a change of direction and a difference between means in that direction significant at the 5 per cent level occurs.

The differences between the means of the remaining 3 of the 18 tests occur in the same direction as the differences between the means of the 10 and 16-year-old groups. These are differences in means for knee and wrist flexion and extension and trunk rotation. The differences in wrist and knee flexion and extension are great enough to be statistically significant.

It should be pointed out that the 18-year-old California subjects vary greatly with respect to at least one selective factor. All boys at ages 10, 12, 14, and 16 are subject to compulsory school attendance laws. All college students and boys in school who are 18 years old have selected a college career or have entered into further educational experience; therefore, each subject used in this study, up to and including the 16-year-old group, has a chance of being representative of the total population for the age group in which he falls. Each subject selected from the college and 18-year-old levels has a chance only of being representative of a selective group, the members of which, because of different interests, have had varied activity and work experiences. This may affect their flexibilities. Also, they may be of a somewhat specialized physical type because of one or more factors, such as heredity, social or economic status, or environment.

Summary

In this study, from ages 10 to 16 years flexibility abilities varied — 8 decreased progressively, 7 decreased somewhat erratically, 2 increased, and 1 showed little or no change. These changes were significant and portrayed definite patterns of increase or decrease, showing that the flexibility abilities characteristic of these ages were primarily those of changing performance ability from one age group to a higher age group. The tendency to decrease in performance ability through the ages sampled was definite and predominant in most of the measurements.

It was apparent that the often assumed high flexibility status of boys up to the age of adolescence is open to considerable question. For the groups studied, these ages are periods of decreasing flexibility for most of the measurements used.

Further study of an 18-year-old group, which was found to be questionable as a group representative of that age, indicated that there were great variations of patterns of flexibility between this and the lower age groups. These findings together with the fact that the patterns of living and habits of body movement of boys over 16 years of age differ because of their varied occupations or education programs, while boys 16 years old and younger are not so widely differentiated, led to the assumption that there was a dividing line with respect to flexibility as far as homogeneous groups are concerned at about age 16.

There is a strong implication in the evidence found in this study that future effort to establish norms of flexibility per-

formance should be undertaken with these findings in mind. The present evidence points to the use of data collected at approximately age 16 as the best basis for the establishment of norms with which all flexibility performance of individuals and of special groups who vary with respect to age, occupation, traumatic conditions and so forth can be compared for interpretive purposes. In any event, this is apparently the first evidence indicating how and at what levels basic norms may be established. Further evidence should be sought to determine its validity.

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Mechanisms in the Production of Hemiparesis Associated with Intracranial Aneurysm. W. Eugene Stern. Brain **78**:503, 1955.

The author reviews the literature and presents several cases concerning the ways in which hemiparesis is caused by intracranial aneurysms.

The coincidence of hemiparesis and aneurysm in all instances depends on the situation of the lesion. Six cases are presented which illustrate the probable mechanisms in the production of hemiparesis by intracranial aneurysms of the congenital, developmental type.

Intracerebral bleeding is probably the chief cause of hemiparesis where an aneurysm is involved. Less often the bleeding may be subdural or subarachnoid. Aneurysms which do not bleed can cause hemiparesis by expanding in a tumor-like fashion to cause compression of the brain substance.

Of less importance is the hemiparesis produced either by direct extension of the thrombosis or occlusion of the parent vessel. Also mentioned is the probability of hemiparesis occurring as a result of ischemia due to spasm or compression of the carotid artery by an aneurysmal mass.

Vaccinia Versus Poliomyelitis. D. P. MacIver. Lancet **270**:226 (Feb. 4) 1956.

All cases of paralytic poliomyelitis in three counties in England were noted over a period of approximately eight years. The incidence in the age range up to 15 years was noted and compared in those who had been inoculated against smallpox and those who had not.

Only in the age range up to three and one-half years was there a significant difference. There the incidence of paralyzing poliomyelitis was only seven per cent in those who had been inoculated. However, only 15 cases were reported in this age range.

In the three and one-half to five year and the five to fifteen year range there was no difference. It would therefore seem that there is no greater incidence of paralyzing poliomyelitis in those who have not been inoculated against smallpox.

Sensory Loss with Poliomyelitis. F. Plum. Neurology **6**:166 (Mar.) 1956.

Pain and cutaneous hyperalgesia are common in acute poliomyelitis, whereas loss of sensation is rare. Two patients are described who suffered severe sensory loss in the lumbosacral dermatomes during acute illnesses otherwise typically that of acute poliomyelitis. Type I poliomyelitis virus was isolated from the stools of one of these patients, who also showed a rising antibody titer to the virus. Both patients had motor involvement of the upper extremities. The observed clinical changes could have been due to a diffuse myelopathy of the lumbosacral spinal cord or extensive damage to dorsal root ganglion cells combined with necrosis of anterior horn cells in the same neural segments. Neuronolysis of the dorsal root ganglia is regarded as the more likely cause of the sensory loss because of the frequency with which pathologic abnormalities are found in these ganglia in human and experimental poliomyelitis.

The Pain Index — A Method for Determining the Progress of Treatment

Alexander Koppel, M.D.
Philadelphia

Lord Kelvin said, "When you can measure what you are speaking about, and express it in numbers, you know something about it." In the light of this statement, a review of recent literature on the subject of pain evaluation is disheartening. Some of our outstanding men have accepted the nihilistic attitude. In 1941, Frederick W. Hark[1] of the University of Illinois began an article with the statement, "Pain is said to be a symptom, an entity of a subjective nature, which cannot be evaluated; and since it cannot be evaluated, it is often neglected." In 1954, L. A. Smith[2] of the Mayo Clinic began his classic article thus: "In their respective ways both the stoic and the neurotic tend to obscure the true pattern of their pain and to hinder the physician in evaluating it." In that same issue of the same journal, Allan S. Russek[3] began an article with the statement, "Treatment by physical means is probably the oldest form of therapy for the relief of pain."

How can we treat pain scientifically if we cannot evaluate it?

Method

Many methods have been used to measure pain. Foremost among these are ordinary palpation, the pinch test, and the pin test. These tests are too elementary and very difficult to evaluate.

The present study is a description of the use of a 600 mm. Hg manometer for the purpose of measuring the reaction to pain due to pressure. It is a modification of a method used for the early diagnosis of phlebothrombosis as described by Lowenberg.[4]

On the desk of almost every physician is an instrument that he has used since the day he was graduated from medical school, which is ideal for measuring pain — the manometer. Besides taking blood pressure, it can be turned into an admirable instrument for evaluating pain. How many times have patients said "ouch" when the blood pressure cuff was inflated a little too much? That was the threshold of pain. It is almost as good as a slide rule; however, there is a difficulty. About 25 per cent of patients do not complain of pain at a pressure of 300 mm. Hg. Therefore, I constructed a 600 mm. Hg manometer, which is an excellent instrument for the measurement of pain.

Method of Charting Data

Patients must be taught the meaning of pain if the test is to be accurate. This is done by dividing the reaction into three parts. As the cuff is inflated, and this should be done slowly, the patient is asked to signal when the cuff feels snug. This point is marked as a circle on the chart. Next he is asked to tell when the cuff feels tight. This point is marked by a solid circle. Inflation of the cuff is continued and the patient is asked to tell when he actually feels pain. This is marked as a solid triangle (fig. 1).

An alternate method is to chart the pain index in the same manner in which a blood pressure reading is charted, but instead of recording the systolic over the diastolic pressure, the touch-pressure-pain reaction is recorded in the following manner, for example: 210/140/40 Hg.

Classification

From a study of over 300 patients, most of whom were treated for 10 to 25 years, I attempted to form a classification (fig. 2 and 3). Cuff pressure was taken on the normal left arm.

Twelve per cent of these patients were considered unreliable. They complained of pain from cuff pressures under 100

Read at the Thirty-third Annual Session of the American Congress of Physical Medicine and Rehabilitation, Detroit, August 30, 1955.
Albert Einstein Medical Center.

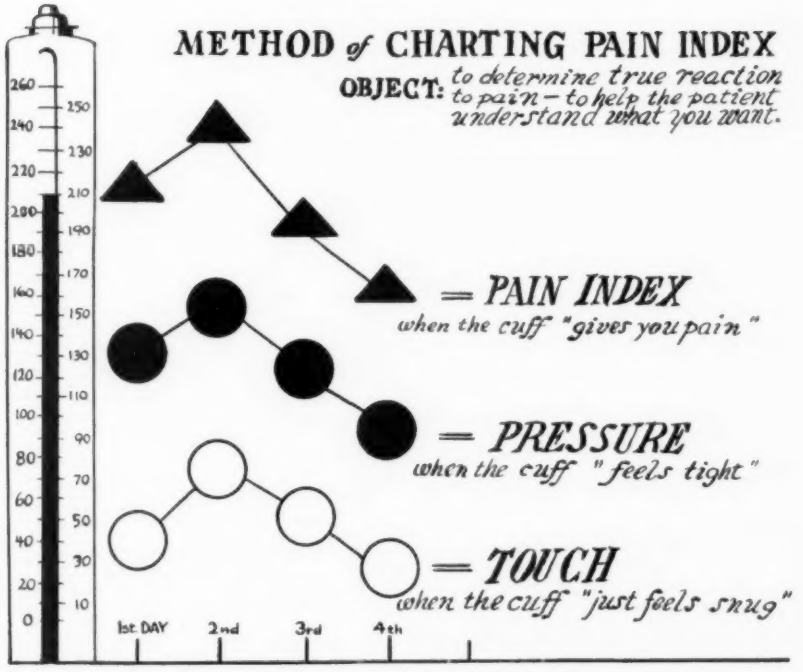

METHOD of CHARTING PAIN INDEX
OBJECT: to determine true reaction to pain — to help the patient understand what you want.
= PAIN INDEX
when the cuff "gives you pain"
= PRESSURE
when the cuff "feels tight"
= TOUCH
when the cuff "just feels snug"
1st DAY
2nd
3rd
4th

Fig. 1 — Method of charting pain index, illustrating the differentiation between the sensation of touch, pressure, and pain index.

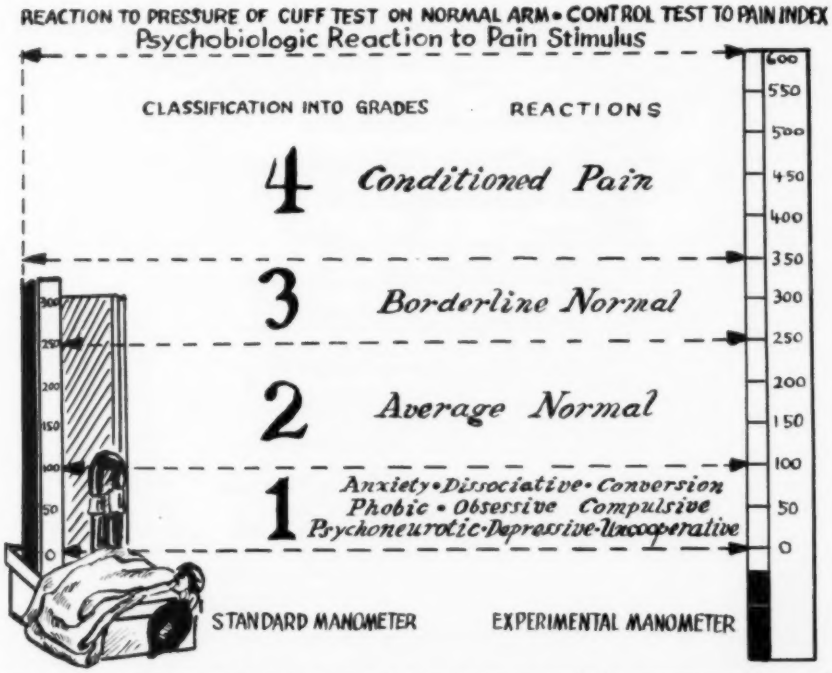

REACTION TO PRESSURE OF CUFF TEST ON NORMAL ARM • CONTROL TEST TO PAIN INDEX
Psychobiologic Reaction to Pain Stimulus
CLASSIFICATION INTO GRADES
REACTIONS
4 Conditioned Pain
3 Borderline Normal
2 Average Normal
1 Anxiety • Dissociative • Conversion
Phobic • Obsessive Compulsive
Psychoneurotic • Depressive • Uncooperative
STANDARD MANOMETER
EXPERIMENTAL MANOMETER

Fig. 2 — A psychobiologic classification of the pain index, acting as a guide for comparative evaluation of patient reaction.

mm. Hg. Some even registered the pressure reaction above that of pain. These patients comprised the following types:

1. Anxiety reaction
2. Dissociative reaction
3. Conversion reaction
4. Phobic reaction
5. Obsessive compulsive reaction
6. Psychoneurotic reaction
7. Depressive reaction
8. Uncooperative reaction

This group was classified as grade 1.

Eighty-eight per cent of the patients were considered reliable. They complained of pain from a cuff pressure over 100 mm. Hg. They were classified into three grades:

Grade 2 — Average normal reaction
Grade 3 — Borderline normal reaction
Grade 4 — Conditioned pain reaction

The term conditioned pain reaction requires explanation. This group comprised about 25 per cent of the patients. They complained of pain from cuff pressures between 350 and 550 mm. Hg. They comprised two types of patients: the so-called stoics, those patients who inherited the type of nervous system that

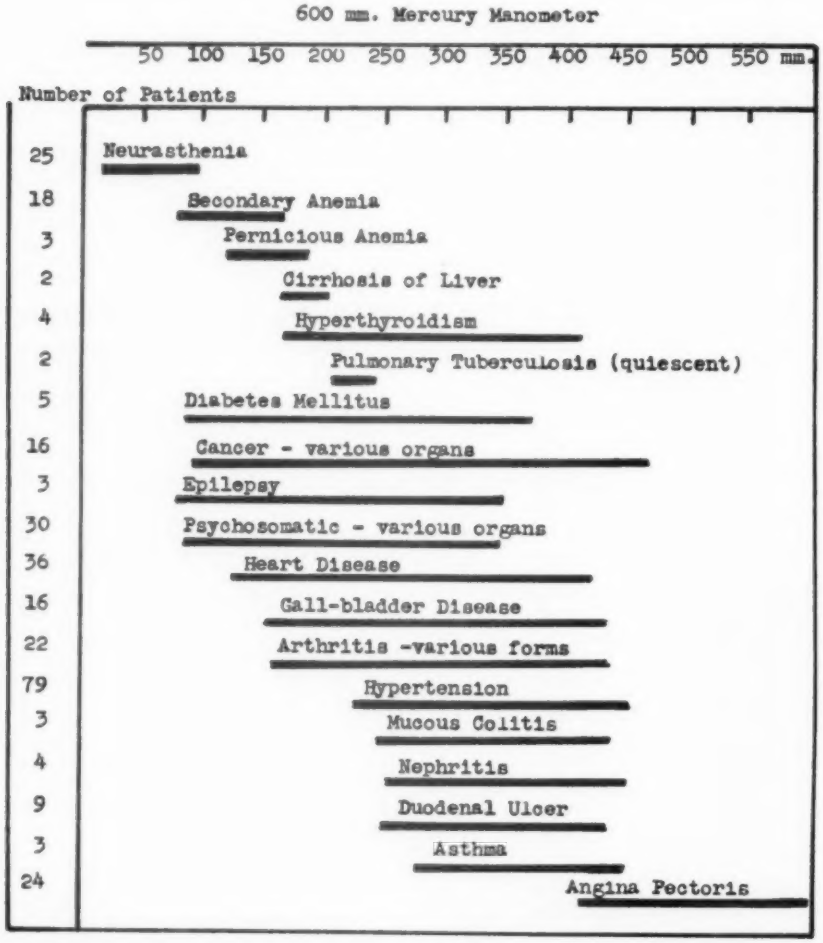
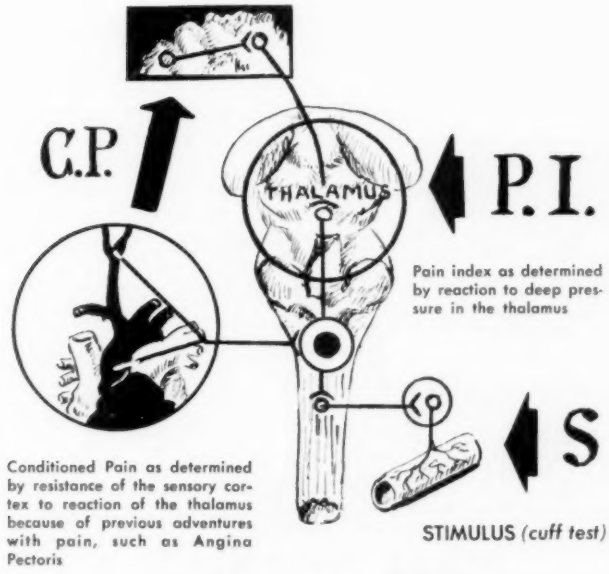


Fig. 3 — Variation in reaction to pain, based on a study of 300 patients with various diseases. Note the position of angina pectoris.


C.P.
THALAMUS
P.I.
Pain index as determined by reaction to deep pressure in the thalamus
S
Conditioned Pain as determined by resistance of the sensory cortex to reaction of the thalamus because of previous adventures with pain, such as Angina Pectoris
STIMULUS (cuff test)

$$P.I. = S + C.P.$$

PAIN INDEX = STIMULUS + CONDITIONED PAIN

Fig. 4 — The equation: Pain index (P. I.) equals stimulus (S) plus conditioned pain (C. P.). Conditioned pain is the resulting factor of interaction between the thalamus and cortex of the brain. This is the principle used in the evaluation of the pain index.

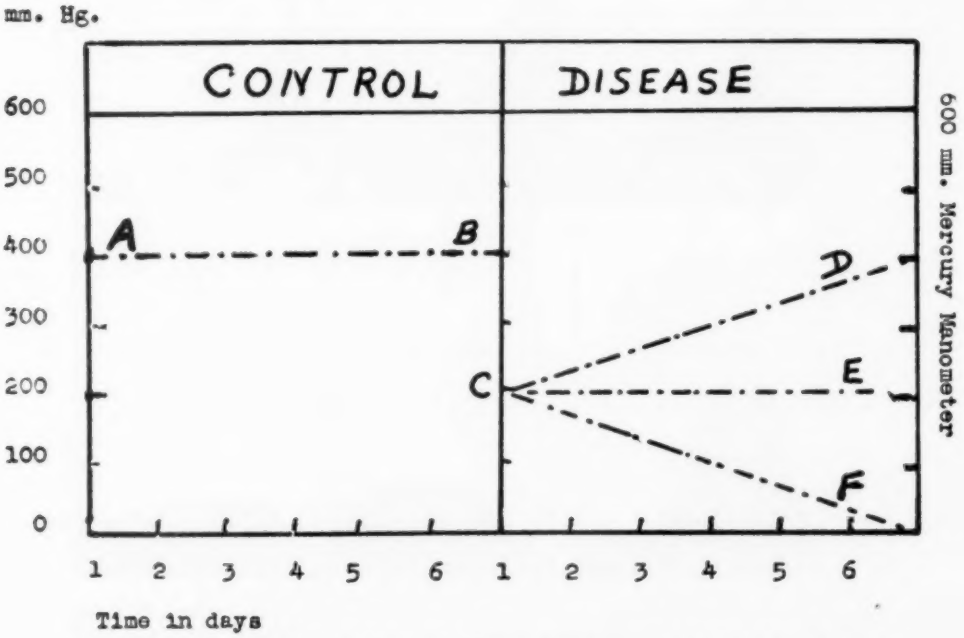


Fig. 5 — Comparative charting to determine the progress of treatment. A — B, pain index of normal extremity. Diseased extremity showing either C — D, improvement; C — E, no improvement; or C — F, degeneration. This is a guide for evaluation of treatment.

reacts slowly to the pain stimulus; and those patients who have built up a certain amount of resistance against the pain stimulus because of previous experience with frequent severe pain. Leading in this group are patients who are suffering from true angina pectoris. In fact, this test may be utilized to differentiate true from false angina pectoris (fig. 4).

Progress of Treatment

When a patient presented himself for treatment, he was first classified by ascertaining his reaction to the pain index test as described. The left arm was used

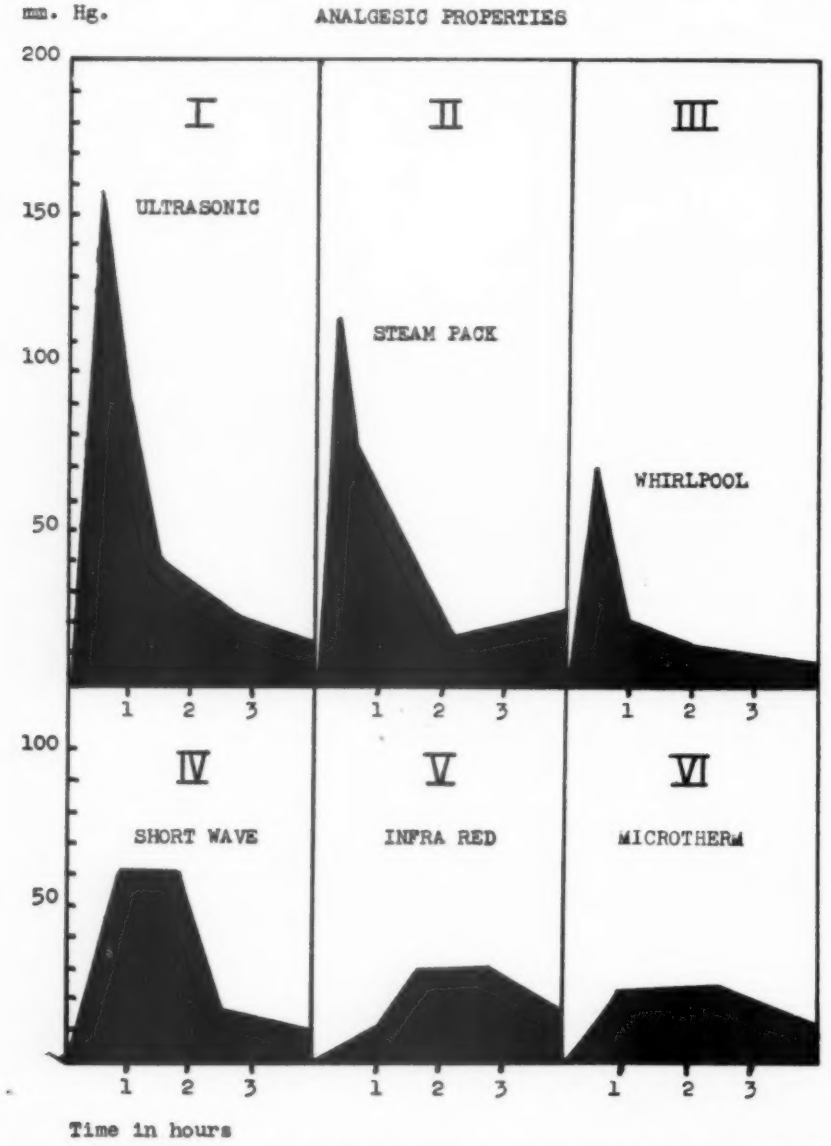


Fig. 6 — Comparative evaluation of the analgesic properties of the various modalities of physical medicine on normal tissue, as determined by pain index.

in this series of studies. For example, with a patient who had a lesion of the left lower extremity, the cuff was placed over the lesion, and the pain index test done. Then the cuff was placed on the normal right lower extremity in the similar position and the pain index recorded. This was the control. As treatment progressed, pain index readings were charted, thus indicating the progress of treatment. By this method treatment can be evaluated (fig. 5). The record resembles a temperature chart. The patient reacts as if he has had a fever — first the storm, then the calm of recovery.

Value of Treatment

By means of the pain index test, the analgesic effect of the various modalities can be determined (fig. 6). These studies were made on my own left arm, and checked on 20 normal people. Each modality was independently used on a separate day, so that they would not affect each other.

It will be noted that the ultrasonic wave gave a greater degree of analgesia than any other modality. This was followed by a sharp fall, but some analgesia after a period of 4 hours was retained. The steam pack and whirlpool acted in a similar manner, but gave a lesser degree of analgesia. Short wave diathermy, infrared radiation, and microtherm therapy gave a lesser immediate analgesic effect, but formed a plateau of analgesia that lasted 1 to 2 hours and did not return to the original pain level after 4 hours.

Summary

A new method for the measurement of pain threshold has been described. A standardized method of procedure has been attempted as the result of the study of 300 patients. The method has proved of value in the treatment of disease: first, by evaluating the progress and value of a given treatment, thus determining whether a treatment should be continued or discarded; and second, it has established a method for determining the analgesic effects of the various modalities that are used in the practice of physical medicine. It has also been suggested as an aid in the diagnosis of angina pectoris.

References

1. Hark, F. W.: Pain in the Muscles, Bones and Joints. M. Clin. North America **25**:63 (Jan.) 1941.
2. Smith, L. A.: The Pattern of Pain in the Diagnosis of Upper Abdominal Disorders. J.A.M.A. **156**:1566 (Dec. 25) 1954.
3. Russek, A. S.: Role of Physical Medicine in Relief of Certain Pain Mechanisms of Shoulder. J.A.M.A. **156**:1575 (Dec. 25) 1954.
4. Lowenberg, R. I.: Early Diagnosis of Phlebothrombosis with Aid of a New Clinical Test. J.A.M.A. **155**:1566 (Aug. 28) 1954.

Observations on Chemical and Neural Mechanisms of Cutaneous Hyperalgesia, Flare and Inflammation. J. A. Harpman, and T. P. Whitehead. Brain **78**:634, 1955.

The authors present a study on some of the aspects of inflammation and flare, as well as a chemical investigation of skin hyperalgesia.

The problem of flare and cutaneous hyperalgesia was studied on human subjects with various degrees of neurological deficit or in combination with local anesthetics.

It was noted that hyperalgesia and flare were only temporarily limited by local anesthetics and that the reaction proceeded normally after the effects of the anesthetic disappeared. This would seem to indicate that a neural mechanism was involved.

It was also noted that areas of hyperalgesia are sometimes delimited by superficial veins and that the reaction often would extend along their course. This would probably implicate the spread of a humeral agent through the lymphatics and tissue spaces.

In attempting to determine what this humeral mechanism was, the authors prepared solutions containing dermis, fibrin and brain tissue. Some of the samples were incubated with enzymes such as pepsin and trypsin prior to injection.

No definite determination as to the exact chemical structure of the humeral process was made but it would seem that the substance is produced in the dermis or epidermis when the skin is injured and in combination with the neural process produces the hyperalgesia, flare and inflammation.

The Quadripedal — A Preambulator

F. W. S. Modern, M.D.
Rudolph Jahn, B.S.
and
George V. Devins, B.A.
Long Beach, Calif.

In hemiplegia and similar motor disturbances, the more disabled the patient and the slower the recovery, the more delayed is the patient's effective retraining. Gait training is usually postponed until the patient is at least able to stand. If retraining of the affected extremity could fall into a pattern motion, retraining should be enhanced considerably.

In order to initiate early motion simulating ambulation in patients still confined to a wheelchair and also to restore the normal motion patterns between right and left, and between the upper and lower extremities and the trunk, we designed the quadripedal (see photograph).

Two bicycle sprockets were connected with a drive chain, the upper sprocket being attached to the handlebar post, the lower sprocket remaining in its customary location. Foot rests were placed on the pedals onto which the patient's feet are strapped. The patient is seated in a wheelchair or standard chair.

The tilt of the bicycle frame and the height of the pedals are adjustable to the patient's convenience. The pedals of the upper sprocket are replaced by handles to which the patient's paralyzed hand may be fastened. The majority of the motor power is supplied by the patient's normal extremities.

The apparatus can be used as soon as the patient is able to sit even if he has to be secured to the wheelchair. The handles can be adjusted either to work

From the Physical Medicine and Rehabilitation Service, VA Hospital.

reciprocally or parallel, depending on the treatment objective.

The apparatus has been in use now for over two years and has proved its usefulness in many conditions besides hemiplegia. Particularly gratifying was the response in the spastic types of multiple sclerosis where spasm and ataxia have prevented effective use of the extremities. The response to the treatment seems to be much more prompt, and patients who apparently have made very slow progress with extensive conventional type exercises have shown gratifying and relatively rapid progress on this apparatus. The early response of the patient has resulted, in many instances in improved morale, augmented effort, and satisfaction with the results that his own efforts have produced.

The principle of integrating upper and lower extremity and trunk motion is also being applied to a standard stationary bicycle in order to carry out a progressive conditioning program paralleling the patient's rehabilitation as he moves into weight-bearing activities.

Reference

1. Redkey, H.: The Community Rehabilitation Center. J. Rehabil. **20**:3 (May-June) 1954.

WE WANT TO KNOW ABOUT YOU —

your activities, local and national, are of interest to us. *Remember, what may not be news to you is news to others.* Please send all information before the 15th of the month. The news blank is for your convenience — **send it today!**

— MEMBERSHIP NEWS —

Archives of Physical Medicine and Rehabilitation

W h o ?

W h a t ?

W h e r e ?

W h e n ?

W h y ?

...ANNUAL REPORTS...

American Congress of Physical Medicine and Rehabilitation

American Academy of Physical Medicine and Rehabilitation

American Registry of Physical Therapists

Report of the Finance Committee

The report of our auditor which follows indicates that for the year ending December 31, 1955, the American Congress of Physical Medicine and Rehabilitation continued to operate on a sound financial basis.

Louis B. Newman
Herbert W. Park
Charles S. Wise
Frank H. Krusen, *Ex-officio*

AMERICAN CONGRESS OF PHYSICAL MEDICINE AND REHABILITATION

Report on Examination For the Year Ended December 31, 1955

May 1, 1956

Board of Governors,
American Congress of Physical Medicine
and Rehabilitation,
30 North Michigan Avenue,
Chicago, Illinois

Dear Sirs:

I have examined the balance sheet of the American Congress of Physical Medicine and Rehabilitation as of December 31, 1955, and the related summary of net income and surplus for the year then ended. My examination was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as I considered necessary in the circumstances, except as stated in the following paragraph.

I did not verify the income from subscriptions to ARCHIVES, a magazine published monthly by the Congress, because it was not considered practicable. However, I tested the correctness of the subscription income recorded on the books by reference to available supporting data.

Based on my examination, limited to exclude verification of ARCHIVES subscription income, in my opinion, the accompanying balance sheet and summary of net income and surplus present fairly the financial position of the American Congress of Physical Medicine and Rehabilitation at December 31, 1955, and the results of its operations for the year then ended in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

I submit the following exhibits:

Exhibit
A—Balance Sheet, December 31, 1955.
B—Summary of Net Income and Surplus for the Year Ended December 31, 1955.

Yours truly,
Joseph Kanovski
Certified Public Accountant

Exhibit A

American Congress of Physical Medicine
and Rehabilitation
(Incorporated in Illinois — Not for Profit)

Balance Sheet, December 31, 1955

Assets

Current Assets:		
Cash:		
Michigan Avenue National Bank of Chicago	$ 8,199.41	
Bell Savings and Loan Association	10,000.00	
Petty Cash	150.00	$18,349.41
Accounts receivable:		
Advertisers and exhibitors	$ 2,030.41	
Membership dues	480.00	
American Registry of Physical Therapists	4,295.34	
American Academy of Physical Medicine and Rehabilitation	534.44	7,340.19
Investments in United States Savings bonds — at cost		58,000.00
Accrued interest		535.86
Deposit at United States Post Office		50.00
Total		$84,275.46

Liabilities

Current Liabilities:		
Accounts payable		$ 921.07
Accrued payroll taxes		312.92
Dr. John S. Coulter Memorial Fund		750.00
Subscriptions to ARCHIVES —unexpired portion		7,299.50
Dues collected in advance — year 1956		320.00
Total current liabilities		$ 9,603.49
Surplus, per Exhibit B		74,671.97
Total		$84,275.46

Exhibit B

American Congress of Physical Medicine and Rehabilitation

Summary of Net Income and Surplus

For the Year Ended December 31, 1955

Income:		
Membership dues		$11,662.00
ARCHIVES:		
Advertising—less discounts — net	$13,206.56	
Subscriptions	16,759.02	
Sale of cuts, etc.	4,200.31	34,165.89
Interest on United States Savings Bonds		1,604.53
Convention income:		
Exhibits	$10,925.00	
Special instruction course	1,086.00	
Total	$12,011.00	
Direct convention expenses	8,435.69	
Convention income —net		3,575.31
Miscellaneous		184.16
Total income		$51,191.89
Expenses:		
Office salaries and expenses:	$30,203.79	
Printing—ARCHIVES	14,627.62	
Cuts, half-tones, electros, etc.	4,070.84	
Pay roll taxes	308.67	
Professional fees	1,251.00	
International Federation of Physical Medicine	661.84	
Special meeting	100.00	
Sundry	891.47	
Total expenses	$52,115.23	
Less share of expenses billed to:		
American Board of Physical Medicine and Rehabilitation	$ 125.00	
American Academy of Physical Medicine and Rehabilitation	250.00	
American Registry of Physical Therapists	12,000.00	
Total	$12,375.00	
Expenses — net		39,740.23
Net income for the year		$11,451.66
Surplus at beginning of the year	$64,036.37	
Adjustment for expenses applicable to the prior year	816.06	63,220.31
Surplus at end of the year		$74,671.97

The report of the auditor which follows indicates that for the year ending December 31, 1955, the American Academy of Physical Medicine and Rehabilitation continued to operate on a sound financial basis.

AMERICAN ACADEMY OF PHYSICAL MEDICINE AND REHABILITATION

Report on Examination For the Year Ended December 31, 1955

May 1, 1956

Board of Governors,
American Academy of Physical Medicine and Rehabilitation,
30 North Michigan Avenue,
Chicago, Illinois

Dear Sirs:

I have examined the balance sheet of the American Academy of Physical Medicine and Rehabilitation as of December 31, 1955, and the related statement of net income and surplus for the year then ended. My examination was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as I considered necessary in the circumstances.

In my opinion, the accompanying balance sheet and statement of net income and surplus present fairly the financial position of the American Academy of Physical Medicine and Rehabilitation at December 31, 1955, and the results of its operations for the year then ended in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

I submit the following exhibits:

Exhibit
A—Balance Sheet, December 31, 1955.
B—Statement of Net Income and Surplus for the Year Ended December 31, 1955.

Yours truly,

Joseph Kanovski
Certified Public Accountant

American Academy of Physical Medicine and Rehabilitation
(Incorporated in Illinois — Not for Profit)

Balance Sheet, December 31, 1955

Assets

Current Assets:		
Cash:		
Michigan Avenue National Bank of Chicago		$ 1,593.54
Bell Savings and Loan Association		2,000.00
Investment in United States Savings bonds —at cost		1,500.00
Accounts receivable—members		45.00
Accrued interest receivable		12.65
Total		$ 5,151.19

Liabilities

Current Liabilities:		
Accounts payable:		
Trade		$ 225.00
American Congress of Physical Medicine and Rehabilitation		534.44
Dues and special assessment collected in advance		140.00
Total current liabilities		$ 899.44
Richard Kovács Memorial Fund	$ 300.00	
Cash—Bell Savings and Loan Association	300.00	
Surplus, per Exhibit B		4,251.75
Total		$ 5,151.19

Exhibit B

American Academy of Physical Medicine and Rehabilitation

Statement of Net Income and Surplus
For the Year Ended December 31, 1955

Income:		
Members' dues		$ 1,830.00
Initiation fees		730.00
Interest		90.67
Total Income		$ 2,650.67
Expenses:		
Share of office expenses billed by American Congress of Physical Medicine and Rehabilitation	$ 250.00	
Special meetings	388.91	
Professional fees	425.00	
Office supplies	517.79	
Miscellaneous	307.39	
Total expense		1,889.09
Net income for the year		$ 761.58
Surplus at beginning of the year	$ 3,507.67	
Adjustment for expenses applicable to the prior year	17.50	3,490.17
Surplus at end of the year		$ 4,251.75

AMERICAN REGISTRY OF PHYSICAL THERAPISTS

Annual Report

January 1 — December 31, 1955

The major activities of the Registry follow the purposes for which it was organized; namely, to promote the art and science of medicine through an understanding and utilization of the functions and procedures of physical therapy in the prevention, treatment or alleviation of human ailments and the maintenance of or restoration to health; to maintain a list of physical therapists competent and qualified to administer adequately physical therapy under the prescription, direction and supervision of licensed physicians, and to promote a widespread utilization of such list to the end that the facilities and methods employed in physical therapy may effectively augment the services of American medicine. All of its activities represent an effort on the part of the Registry to carry out its original purposes. No phase of service is overlooked in this effort.

Dr. James W. Rae, Jr., was appointed to serve on the Board for a period of seven years beginning January 1, 1956. He was selected to replace Dr. Jessie Wright.

Misses Margaret Moore and Elizabeth Wood, representing the American Physical Therapy Association, were reappointed to serve on the Board for a period of two years beginning January 1, 1956.

At the Interim Meeting, April 2, 1955, Hotel Roosevelt, New York City, the following motions were passed:

Second retake examination to be set up as a standard operating procedure, administered by the central office and not submitted to the Board, using the same stipulations as previously recommended by the Board.

Change the Registry By-Laws, under "Objects of the Registry" from 1) to promote the art and science of medicine through an understanding and utilization of the functions and procedures of physical medicine in the prevention, treatment, or alleviation of human ailments and the maintenance of or restoration to health *to* 1) to promote the art and science of medicine through an understanding and utilization of the functions and procedures of physical therapy.....

In Registry booklet of information, under "Qualifications of Applicants for Registration," delete the following statement: 1) (a) Either graduation from an accredited school of nursing or physical education, or two years of approved college training, including satisfactory courses in biology and other sciences.

Registry office to prepare a form to be completed by the schools which would give each student for the permanent file, an individual statement of certification to completion of physical therapy training.

Sum of $2000 authorized to be paid American Congress of Physical Medicine and Rehabilitation for additional secretarial assistance for the period January 1 — December 31, 1954.

At the Annual Meeting, August 28, 1955, Hotel Statler, Detroit, the following motions were passed:

All physical therapy schools to receive copies of the pool of questions from which future Registry examinations are prepared.

Interim revision of Registry examination to be made.

Monthly retainer fee for legal counsel to be increased.

Sum of $2500 to be contributed to World Confederation for Physical Therapy.

Chairman to appoint committee of three to draw a preliminary draft of a second inquiry letter to those questioned on the self-employment practices as well as any possible violation of the code of ethics; this letter to be in the nature of a questionnaire, such questionnaire to be circulated throughout the Registry Board prior to the next interim meeting.

Effective January, 1956, all newly registered physical therapists are to receive, without charge, one Registry pin and one emblem *(this motion applies to 1956 applicants only)*.

Election of Dr. Earl C. Elkins, Chairman of the Board; Dr. Robert L. Bennett, Vice-Chairman, and Dorothea C. Augustin, Registrar-Secretary-Treasurer.

A number of special problems were considered and several interim actions were completed by the Registry Board in 1955.

The following registrations were cancelled: Miss Lillian C. Bailey, 424 24th St., Manhattan Beach, Calif.; Mr. James B. Gregg, 3 Chambersburg St., Gettysburg, Pa., and Mr. Carrol J. Martin, PO Box 86, Wylie, Texas.

The following members were reinstated: Miss Beth Bagley, 4251 Crittenden Ave., Indianapolis, Ind.; Miss Ruth I. Ryan, 1012 First St. N. W., Rochester, Minn., and Mrs. Gladys F. Krohn, 1417 W. Pine St., Stillwater, Minn.

The following members have been dropped from the roster of therapists in good standing for non-payment of dues: June E. Anderson, Fern M. Archie, Gordon L. Avery, Helen E. Batten, Helen C. Bellows, Shirley L. Benford, Margaret V. Beyda, Betty Q. Brandt, Helen Bunclark, Donald S. Campbell, Francis J. Cantrell, Jeanne L. Capes, Carmen Collazo, Ruth Cook, Carol J. Corder, Mary T. Coughlin, Gloria P. Davison, Malcolm C. Dixon, Jean S. Dunbrook, Esther M. Eklund, Beulah T. Embry, Madeline M. Faller, Sallie I. Figgatt, Anne L. Franklin, Dorothea A. Gee, Alexander Geller, Claire T. Giuranna, June B. Glaze, Geraldine M. Gorman, Pauline N. Graham, Laura L. Greer, Harold D. Gridley, Hazel E. Grime, Martha Ann Gross, Bernis M. Hanlon, Elna M. Hauser, Marian W. Hawkins, Avin Hill, Ida S. Howe, Min-Shan L. Huang, Jacqueline E. Jackson, Geneva R. Johnson, Carlton L. Jones, Margaret T. Keckley, Dorothy H. Kelly, Bernard Kimmel, Elizabeth E. Kinzer, Penelope M. Koch, Samuel Kossack, Jeanne L. Linquist, Luz Maria Lopetegui, Gladys S. Lynch, Mary Elizabeth MacDonald, Anne C. Malek, Marion E. Mankin, Richard A. Markoff, Ann S. McKinnon, Stephanie O. McVicker, Emma W. Melero, Carolyn F. Morse, Dorothea B. Nell, James E. Pears, Alice D. Price, Doris E. Reed, Mary Lee Richards, Margaret M. Richmond, Elsie A. Riley, Mary H. Ritacco, Charles P. Schuch, Harold Schwartz, Ingrid L. Sinervo, Charles H. Singer, Alice L. Slater, Doris E. Smith, Helen A. Smith, Wanda H. Smith, Helen B. Steinborg, Nancy A. Stenner, Donna M. Sullivan, Helen B. Supina, Norman R. Swenson, Ruth N. Tatum, Sara M. Tyler, Vivian A. Urmanski, Grace M. Watson, Eleanore E. Welch, Priscilla B. Wiese, Dorothy M. Wilke, Jessie H. Wilken, Donna Mae Winters, Esther Wohlgemuth, Anna B. Wolff, Lulu P. Wood, and Robert C. Zehner.

The following members have dropped their membership: Ann F. Anderson, Alice L. Baker, Doris C. Banfield, Marian F. Bennett, Gudrun Brask, Elinor W. Brown, Rose Marie Castagna, Lucille H. Cherry, Elsie T. Child, Margaret H. Clare, Mary B. Coler, Nadene Coyne, Laura L. Crewson, Violet C. Cunningham, Evelyn W. De Mars, Dorothy M. Dequine, Robert G. Dicus, Wade R. Eckert, Marion E. Garland, Dorothy M. Getz, Helen P. Haiber, Ruth L. Henthorn, Helen K. Hickey, Martha E. Hindman, Ethel S.

Hosterman, Alma Hubbard, Hyman Jampol, Edith L. Kristeller, Mary M. Laughlin, Edwin Lavin, Edna Lura, Margaret G. Major, Joan M. Mason, Samuel G. McCaig, Marlen D. McGhie, Nancy G. McIver, Merton E. Miller, Nettie L. Modesti, Shirley C. Moll, Miss John L. Moreland, Joyce O. Morris, Joseph E. Mulroy, William Murray, Harriette E. Nelson, Priscilla C. Nielsen, Elizabeth H. Officer, Dorothy L. Packouz, Edna Pare, Inez W. Peacock, Florence L. Phenix, Anita W. Preston, Alice W. Roszell, Lettie S. Schwanz, Mary Sokoloff, Lila Stevenson, Leon H. Stutzman, Inga H. Teig, Fannie B. Telfer, Marjorie Van Horn, Clara B. Vargason, Ruth H. Walsh, Leonore H. Webber, Barbara C. White, and Elizabeth M. Wiggins.

The following members are deceased: Janet C. Bruce, Grace A. Cinquemani, Marjorie M. Crawford, Treth deVerelle, Mildred I. Hollenbach, Ann Kelley, Cynthia M. Mabbette, Virginia S. Richardson, Kathryn Roeschen, Helen L. Varelia, and Beatrice A. Woodcock.

Certificates Issued According to School of Graduation

Name of School	Number of Graduates Registered
Albany Hospital, Albany, N. Y.	3
Baylor University Hospital, Grady Vaughn School	23
Boston University, College of Physical Education for Women, Sargent College, Cambridge, Mass.	19
Bouve-Boston School of Physical Education, Medford, Mass.	21
University of Buffalo, Buffalo, N. Y.	8
University of California, School of Medicine, San Francisco	22
Charity Hospital of Louisiana, New Orleans	8
Children's Hospital, Los Angeles	13
College of Medical Evangelists, Los Angeles	15
University of Colorado, Denver	11
Columbia University, College of Physicians and Surgeons, New York City	21
University of Connecticut, Storrs	14
Hermann Hospital, Houston, Texas	8
State University of Iowa College of Medicine, Iowa City	21
University of Kansas Medical Center, Kansas City, Kans.	23
Mayo Clinic, Rochester, Minn.	27
Medical College of Virginia, Richmond	35
University of Michigan, Ann Arbor	12
University of Minnesota, Medical School, Minneapolis	6
New York University, School of Education, New York City	4
Northwestern University Medical School, Chicago	20
Division of Physical Therapy, School of Auxiliary Medical Services, University of Pennsylvania, Philadelphia	43
St. Louis University, St. Louis	19
Simmons College, Boston	14
University of Southern California, Los Angeles	20
Stanford University, Stanford University, Calif.	27
University of Texas School of Medicine, Galveston	7
Washington University School of Medicine, St. Louis	8
D. T. Watson School of Physiatrics, Leetsdale, Pa.	18
University of Wisconsin Medical School, Madison	17
Medical Department — U. S. Army	
Brooke Army Medical Center, Ft. Sam Houston, Texas	5
Letterman Army Hospital, San Francisco	6
Walter Reed Army Hospital, Washington, D. C.	8
TOTAL	526
Number of registrations completed	526
Number of examinations conducted	549
Number of retake examinations conducted	22

CORRECTION: In the Annual Report of the American Registry of Physical Therapists for 1954, Bouve-Boston School of Physical Education was listed as having 12 graduates registered; this should have read 21 graduates were registered in 1954.

The report of the auditor which follows indicates that for the year ending December 31, 1955, the American Registry of Physical Therapists continued to operate on a sound financial basis.

AMERICAN REGISTRY OF PHYSICAL THERAPISTS

Report on Examination For the Year Ended December 31, 1955

May 1, 1956

Board of Registry,
American Registry of Physical Therapists,
30 North Michigan Avenue,
Chicago, Illinois

Dear Sirs:

I have examined the balance sheet of the American Registry of Physical Therapists as of December 31, 1955, and the related statements of net income and surplus for the year then ended. My examination was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as I considered necessary in the circumstances.

In my opinion, the accompanying balance sheet and statement of net income and surplus present fairly the financial position of the American Registry of Physical Therapists at December 31, 1955, and the results of its operations for the year then ended in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

I submit the following exhibits:

Exhibit
A—Balance Sheet, December 31, 1955.
B—Statement of Net Income and Surplus for the Year Ended December 31, 1955.

Yours truly,

Joseph Kanovski
Certified Public Accountant

Exhibit A

American Registry of Physical Therapists
(Incorporated in Illinois — Not for Profit)

Balance Sheet, December 31, 1955

Assets

Current Assets:		
Cash:		
Michigan Avenue National Bank of Chicago	$23,923.14	
Bell Savings and Loan Association	2,500.00	$26,423.14
Accounts receivable — dues and registration	$ 1,218.00	
Less reserve for possible losses	650.00	568.00
United States Savings bonds —at cost		45,000.00
Accrued interest		409.97
Total		$72,401.11

Liabilities

Current Liabilities:		
Accounts payable:		
Trade	$ 2,355.35	
American Congress of Physical Medicine and Rehabilitation	4,295.34	$ 6,650.69
Accrued federal excise tax		21.15
Dues collected in advance —year 1956		16,068.00
Deposits with applications (subject to refund if applications are rejected)		1,545.00
Total current liabilities		$24,284.84
Surplus, per Exhibit B		48,116.27
Total		$72,401.11

Exhibit B

American Registry of Physical Therapists

Statement of Net Income and Surplus
for the Year Ended December 31, 1955

Income:		
Dues		$18,350.00
Registration fees		8,010.00
Sales:		
Pins	$ 670.50	
Emblems	467.75	
Directory	145.00	1,283.25
Interest		1,205.33
Miscellaneous		14.08
Total income		$28,862.66
Expenses:		
Share of office expense billed by American Congress of Physical Medicine and Rehabilitation	$12,000.00	
Examinations — supervision and grading	1,597.00	
Board meeting	827.37	
Purchase of pins	500.00	
Office supplies	2,378.41	
Special conferences	1,810.69	
Office equipment	563.15	
Fidelity bond premium	35.65	
Professional fees	2,042.00	
Provision for losses on uncollectible dues	145.00	
Purchase of emblems	98.28	
Donation to World Confederation for Physical Therapy	2,500.00	
Legislative Committee	2,160.00	
Miscellaneous	81.81	
Total expenses		26,739.36
Net income for the year		$ 2,123.30
Surplus at beginning of the year		$45,992.97
Surplus at end of the year		$48,116.27

Respectfully submitted,

Dorothea C. Augustin

AMERICAN REGISTRY OF PHYSICAL THERAPISTS
Dorothea C. Augustin, Registrar

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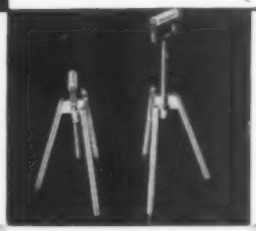

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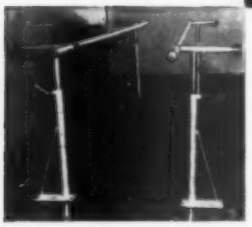

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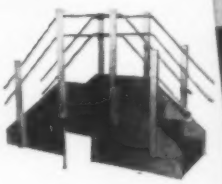

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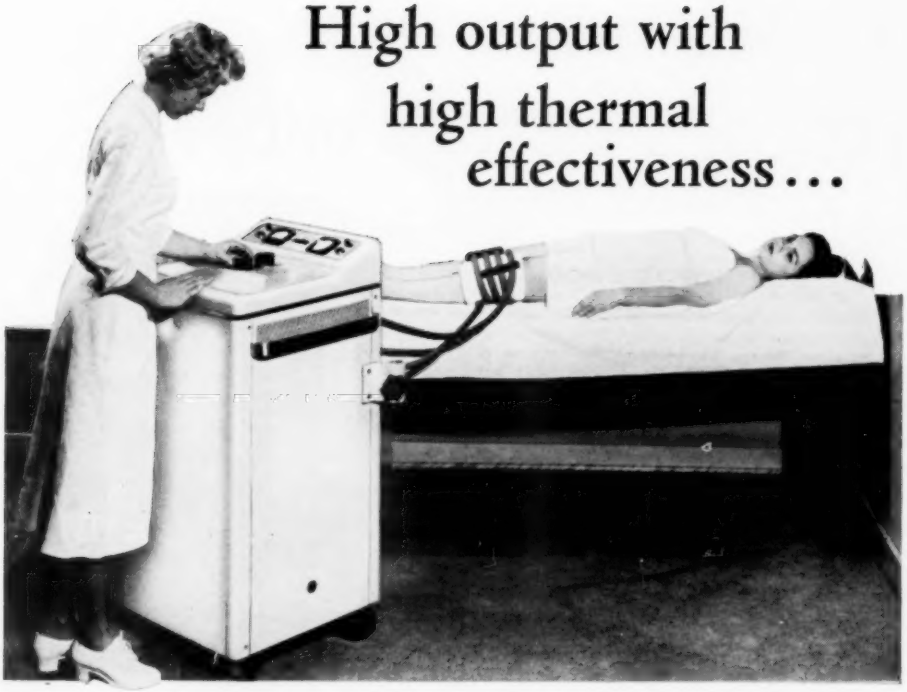

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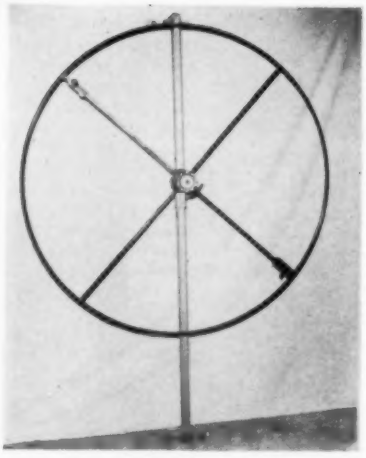

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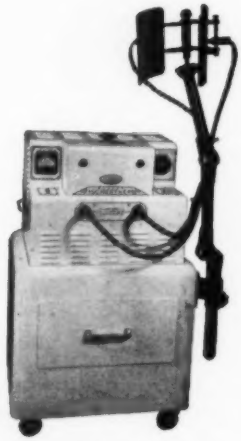

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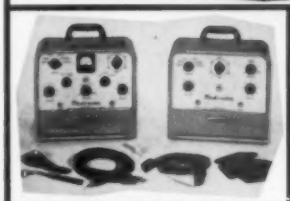

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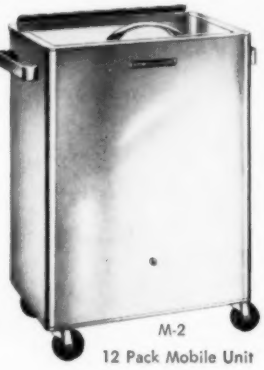

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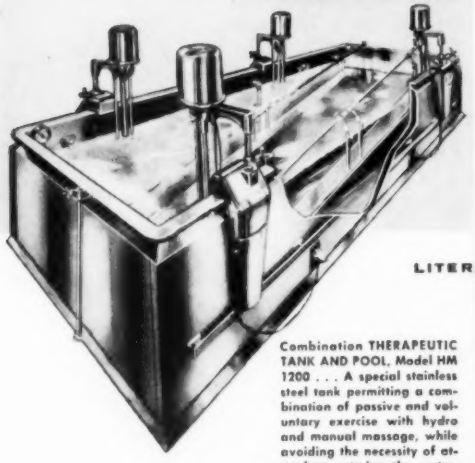

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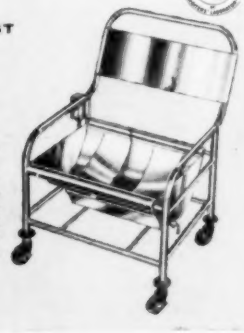

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*indicated therapy for treatment of **TRAUMATIC INJURY**

In the treatment of 590 cases of acute traumatic conditions: myositis, fibrositis, and sprains of the ankle, knee and wrist, 93% relief and cessation of symptoms was obtained by ultrasonic therapy. Leading athletic physicians as well as general practitioners are finding ultrasonics invaluable.

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